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A COMPARATIVE STUDY ON THE QUALITY CONTROL OF FINE JUTE YARN CONVENTIONAL DRAWING METHOD VS MODIFIED DRAWING METHOD

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ABSTRACT

Drawing frame plays an important role on yarn quality. Traditional drawing frames are used for regular jute yarn. After some modifications in the pinning system of the 3rd drawing frame will improve the quality of the output sliver. This sliver is producing regular and fine jute yarn with higher tensile strength, work of rupture, breaking elongation, packing factor and quality ratio. The produced modified yarn was also more regular and uniform comparing to the traditional drawing frame.

KEY WORDS : Drawing frame, Jute, Packing factor, Specific flexural rigidity, Specific work of rupture.

1. INTRODUCTION

Jute is a natural cellulosic bast fiber. Due to its good spin able characteristics, it is a good textile fiber. It is well known as a golden fiber and earns the highest currency from this crop. Jute grows abundantly in Bangladesh having best quality in comparison with India. At present jute and jute goods are suffering many problems both in home and abroad. International market of jute and jute goods is now suffering from decreasing fund of price for not only the synthetic fiber come in competition but also the inferior quality. Jute and jute goods supplied by Bangladesh in the international market and quality control of those goods are not maintained properly (Ranjan 1985, Salam 1995).

Emphasize on the quality control of jute products can at least partially overcome the present unhappy situation of the jute. Improved the quality of jute product if the condition of existing machines are good and parameters are available along with qualified quality control personnel and good supervision. Maximum jute industries are running with most of the old pattern machinery, which installed during the early stage of Pakistan. At present in Bangladesh, life cycle of maximum machines has become expired due to lack of proper repair and maintenance. India is producing good quality yarn even from low-grade raw jute using modified and developed existing machinery (Atkinson 1966). Bangladesh may also produce good quality yarn from low-grade jute if the machine parameters are changed, so research in this area is very much needed.

In present study, focuses on the value of tensile strength and quality ratio of jute yarn by the modified pin arrangement of the 3rd drawing frame. So parameters are raw jute to yarn as because a good quality yarn is the prerequisite condition to get a good quality finished product (Mahabubuzzaman, 2002). This spun yarn is traditionally used in packaging and carpet backing. Now a days, it is used in various diversified areas namely, floor-coverings, household textiles, technical textiles, reinforced plastics, handicrafts etc (Ranganathan, 1993). Therefore, an attempt was made to compare the quality of yarn of same count spun from same grade of raw jute by using both conventional draw frame line and modified draw frame line.

2. MATERIALS AND METHODS

2.1 Materials

Bangla Tossa-B (*Corchorus olitorius*) (Sadaruddin) grade of jute fiber with linear density 2.13 was used for spinning of yarns. The tenacity and elongation at break of jute fiber is 30.1 cN/tex and 1.54% respectively.

2.2 Methods

2.2.1 Preparation of yarn

The raw jute fibers were softened in the softener machine with an application of 25% emulsion on the weight of fibers. Then the soften jute fibers were stored in a bin for pilling or conditioning for a period of 24 hours as commonly practiced in jute mills and these pilled fibers were processed through conventional jute processing sequence i.e. breaker card, finisher card, 1st , 2nd and 3rd drawing frame machine. Drafting and drawing zone of the existing 3rd drawing machine was changed with different pin arrangements of the faller bars. Gap between pins, size, and shape of the pins of the drawing zone are responsible for the quality of jute sliver. Pin arrangement and its distribution improve the sliver quality for the production of fine jute yarn (Ranjan, 1973 Sheikh 1982). Two different pin settings were used in the drawing process. The specification of the modified and existing faller bars are given below in the "Table 1".

Table 1 : Specification *of faller bar*

Existing Faller bar specification	**Modified Faller bar specification**
1. No. of Faller bar = 36	1. No. of Faller bar = 36
2. Total Pin assembly length = 72 mm	2. Total Pin assembly length = 72 mm
3. Total No. of Pin assembly = 4	3. Total No. of Pin assembly = 4
4. No. of Pins per assembly = 18	4. No. of Pins per assembly = 20
5. Pin to Pin Gap in each assembly = 4 mm	5. Pin to Pin Gap in each assembly = 3.5 mm
6. Pin assembly to pin assembly gap= 67 mm	6. Pin assembly to pin assembly gap = 67 mm

The 2nd drawing sliver was passed through modified 3rd drawing machine. The output sliver was spun through apron draft spinning machine having spindles speed 4200 rpm for spinning yarns of 5 lbs/spy (count in tex system= lbs/spy × 34.45) = (172.25 tex).

2.2.2 Determination of tensile property and quality ratio

The tensile properties of yarns were evaluated at 65±2% RH and 27±2ºC (British Standard Hand Book No. 11) on an Instron Tensile Tester. Yarns were tested in 300 mm test length and 250 mm/min cross-head speed. The quality ratio was calculated using the following relationship.

$$\text{Quality ratio (\%)} = \frac{\text{Tensile strength in lbs}}{\text{Count of yarn (lbs/spy)}} \times 100$$

2.2.3 Determination of Flexural Rigidity

The bending rigidity of yarn, expressed as specific flexural rigidity was measured by the ring loop method and test yarn was calculated following the method suggested by Morton and Hearle (Morton W.E and Hearle, 1975).

2.2.4 Determination of packing factor

The packing factor of the yarn was calculated from the fiber density and apparent yarn density duly accounting for its linear density and diameter. The diameter of yarn was measured with a projection microscope (magnification, 10

X). Packing factor was calculated (Goswami et al) from the yarn diameter and considering the density of jute fiber 1.48. The packing fraction was calculated using the following formula-

$$\text{Packing factor} = \frac{\text{Apparent yarn density}}{\text{Fiber density}}$$

3. RESULTS AND DISCUSSION

3rd drawing sliver was spun through apron draft spinning machine. Physical properties of both produced yarn 'A' &' B' was measured. The test results of produced yarns are given in Table 2, 3 and 4. Quality ratio is the property of jute yarn, which indicates the load at break (lbs/count). Yarn of higher quality ratio indicates also yarn of higher strength. So, it is generally said that high tenacity at break causes maximum quality ratio. In this experiment, it is observed from Table 2 and 3 that the tenacity of modified yarn (A) is better than existing (B) yarn and also shows the produced modified yarn's (A) quality ratio increase with the increase of tenacity, which is shown in "Table 3".

Table 2 : Quality ratio of 5 lbs/spy jute yarn by the existing pin arrangement of drawing machine at the temperature of 27 ± 2^{0}C and R.H 65 ± 2%

Sl No	Tensile Strength (lbs)	Average Tensile Strength (lbs)	Standard Deviation (SD) for Tensile Strength	Coefficient of Variation (CV%) for Tensile Strength	Quality Ratio (QR%)
1	4.7	4.42	0.1248	2.823	88.40
2	4.3				
3	4.4				
4	4.3				
5	4.4				
6	4.4				
7	4.3				
8	4.4				
9	4.4				
10	4.6				

Table 3 : Quality ratio of 5 lbs/spy jute yarn by the modified pin arrangements of 3rd drawing frame at the temperature of 27 ± 2^{0}C and R.H 65 ± 2%

Sl No	Tensile Strength (lbs)	Average Tensile Strength (lbs)	Standard Deviation (SD) for Tensile Strength	Coefficient of Variation (CV%) for Tensile Strength	Quality Ratio (QR%)
1	4.8	4.72	0.1248	2.644	94.4
2	4.9				
3	4.8				
4	4.7				
5	4.7				
6	4.8				
7	4.8				
8	4.7				
9	4.5				
10	4.5				

** lbs/spy indicates the fineness or coarseness of yarn and it is determined by the weight of 14400 yards (= 1 spyndle) length of yarn in pounds (lb).

Table 4 : Physical properties of both produced yarn at the temperature of 27 ± 2^{0}C and R.H 65 ± 2%.

Types of yarn	Breaking tenacity, cN/tex	Breaking elongation, %	Specific work of rupture, mJ/tex-m	Packing factor	Specific flexural rigidity, (cN-cm^2/tex^2)
A	8.01	1.86	0.887 (29.46)	0.135 (18.25)	0.454 (15.39)
B	7.90	1.50	0.782 (33.37)	0.134 (18.20)	0.472 (17.19)

Values in the parenthesis denotes the CV% .

A= Modified machine produced yarn; B= Existing machine produced yarn.

Again it is observed from Table 4 that the higher packing factor, the higher is the tenacity, breaking elongation, specific work of rupture and the lower is the specific flexural rigidity. As the number of fiber increases in the yarn, the change in structure improves the regularity and inters yarn radial forces, which in turn, improve the effective contribution of fiber length towards the tenacity. Higher packing in higher number of fiber is the result of higher radial forces between yarns. A pressure is developed to the outside of each single fiber (component) during tensile deformation, therefore, relative fiber mobility within and between the yarns in higher as the number of fiber increases which is reflected in lower specific flexural rigidity.

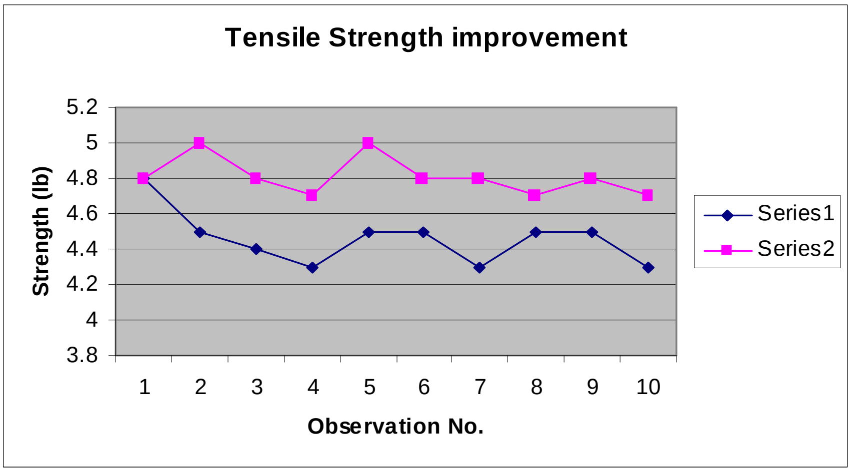

Figure 1 : Tensile strength of produced yarn

Series 1: Produced yarn tensile strength from existing (B) pin arrangement of draw frame.

Series 2: Produced yarn tensile strength from modified (A) pin arrangement of 3rd draw frame.

4. COST FACTOR

As mentioned earlier, better quality yarn can easily be prepared in modified drawing machine. So, manufacturing of high quality yarn does not require any new machine. Need only a simple modification of 3rd drawing machine drafting zone (approximately Taka 150 to 200 per drawing frame). Thus capital investment for making the yarn is much less. The raw material for both yarns is same. So, it may be stated that manufacturing of better quality yarn in modified jute drawing machine would be highly cost effective as this value added high performing jute yarn may be marketed at a much higher price.

5. APPLICATIONS

Improvement of such yarn properties as tensile, flexural, work of rupture, breaking elongation and packing factor of jute yarn opened up some new areas of use for jute fiber for which jute has never been thought off. Disposable fancy carry-bags with different color effects for- i) wine, perfume, medicine bottle etc. ii) shopping bag iii) ladies purse iv) school bag v) travelling luggage bag etc. presently, these items are made from 100% synthetic material which are not environment friendly. Improvement in yarn property parameters, spinning productivity and marginal capital investment may encourage entrepreneur, if the message of development of this technology could reach to the people all over the world.

6. CONCLUSION

From the study, it was clearly exhibited that tensile strength, work of rupture, breaking elongation, packing factor, quality ratio, coefficient of variation and standard deviation of produced yarn was better due to modified system. The produced modified yarn was more regular and uniform comparing to the existing drawing frame. As a result, pin arrangements of the drawing machine shows positive impacts on yarn properties.

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