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EFFECT OF SPINDLE SPEED ON THE PHYSICAL PROPERTIES OF JUTE-COTTON BLENDED RING SPUN YARN

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ABSTRACT

In this research, jute fibers were treated to improve their properties. Treated jute fiber bundles were blended with cotton and spun on a cotton processing system to yield blended 10:90, 20:80 30:70 jute/cotton blended yams. The present study aims to investigate the effects of four different ring spinning spindle speeds on the quality of jute-cotton blended ring spun yarns. The spindle speed variation in this study was between 8,000 to 9,500 rpm. The effect of spindle speed on the physical properties of yarn was investigated. The strength of 18^S count 20:80 jute-cotton blended yarn was seen to have a lower value than 10:90 jute-cotton blended yarns as spindle speed increased. U%, thick place, thin place and total imperfections per 1000 meters showed a tendency to increase with spindle speed. But breaking extension decreased with the increased in spindle speed. As regards yarn hairiness, the effects are significant, hairiness increasing with speeds. It was judged from the experimental findings that the yarn produced from 10:90 jute-cotton blended had higher strength and more uniform than the yarn produced from 30:70 jute-cotton blended yarn with increased spindle speed.

Keywords: Spindle Speed, Blending, Yarn.

1. INTRODUCTION

Jute is a vegetable fibre derived from the barks of an annual plant grown mainly in the sub-tropical area of Asia. Important characteristics of jute fibre are its silky, luster, high tensile strength, low extensibility, and considerable heat and fire resistance. Because of its great abundance and shortage of cotton jute is blended with cotton and jute cotton blended yarns are manufactured mainly to take advantages of the lower price of jute fibre. Blending offers ways of reaching new and better products in which the good features of one fibre argument and complement those of another. Hoffman and Peterson [1] in their work described engineering principles & methods of blending with the aim of improving levels of aesthetic and functional performance of blended fabrics. In a study, Sharma et al [2] examined the various methods of blending jute with acrylic fibres on ring and rotor spinning systems to produce less expensive yams for the knit fabrics sector. The resultant jute blended yams exhibited higher tenacity and lower elongation than those of 100% acrylic yams. Open-end spinning produced yams with improved elongation when jute was blended with acrylic fibers in 30/70 ratio. Chellamani et al [3] "'have been able to use existing machinery in manufacturing jute/cotton blended yams commercially. An overview" of the advantages and disadvantages of producing jute blends using open end, friction and air jet spinning systems revealed that jute is suitable for blending with acrylic, viscose and cotton and DREF spinning can be used for heterogeneous jute blends. As a part of national research program to improve the quality of jute yams and to diversify the application of jute, the SITRA (South Indian Textile Research Association) has developed a blending draw frame that improves the uniformity of jute/cotton blends. The technology made it possible to spin jute/cotton yam in the range of 6/1 to 8/1 counts in the rotor spinning system and 10/1 to 12/1 in the ring spinning system. Using cotton spinning system machinery blends of jute with cotton, viscose and polyester were successfully spun [4]. There are more reports on the feasibility study of spinning of jute blends on cotton spinning machinery along with investigations into the problems involved therein. Chowdhuri et al [5] explained various methods of spinning jute and its blends emphasizing on the importance of fibre length. They also discussed modification in open-end rotor and ring spinning machinery for processing jute and jute blends. The compositions of cotton-jute blends at various stages of

processing from blow room to ring frame had been analyzed using an X-ray diffraction method. The study revealed that the reduction in the nominal jute content observed in the ring yarn is due to preferential losses of their fibre under the licker-in region. Rotor spun jute and polyester blended yams of different blend ratios were subjected to a chemical texturing or bulking process by using caustic soda solutions of different concentrations at different temperatures. Among the various blend compositions employed, a 70/30 Jute/Polyester composition produced the best bulking effect and strength retention when an 15% (w/w) NaOH solution was applied at 25° C. A particular variety of jute was found ideal for diversified end uses for spinning lighter count yams on different blends with cotton in 100% jute system. Another work showed that bulked yarns made from jute-synthetic blends can have physical and mechanical properties comparable to commercially available woolen and acrylic yams. In BJRJ a good number of works on jute multi-fibre system i.e. blending with different natural and man-made fibers had already been carried out. Yarns of jute blended with acrylic and rayon in different proportions were studied [6]. A decrease in the quality ratio with the increase of the percentages of the man-made fibres was found in the study. Again, processing performance in terms of spinning of jute fibre was found to have improved significantly by blending with acrylic fibre [7]. The physical properties and surface features of yams produced from blends of jute and acrylic were superior to that from 100% jute. Finally jute/acrylic blended yams were used in producing carpet, blanket, furnishing and apparel fabrics. Different performance characteristics viz. feel, appearance, durability, comfort properties, crease resistance properties and abrasion resistance were found to have improved than those not only of all jute but also of jute-cotton union fabrics. There had also been report on blending of jute with acrylic from the compatibility point of view.

Moreover, in the Jute Textile Product Development Centre, the previous Jutton Project, jute has been successfully blended with various textile fibres viz. cotton, silk, wool, acrylic, polyester, rayon etc in cotton spinning system. Attempts have been made to produce yarns by blending cotton with chemically modified jute. The qualities of the yarns when blended in 20:80 (jute/cotton) ratio were found to be of as good quality as 100% cotton yarns of improved appearance and quality. The productivity of ring
frame is a major factor contributing to the profitability of a spinning mill and higher spindle speed has become necessary for higher productivity [8]. Problems encountered in spinning yarns at high spindle speeds include yarn breakage rate, hairiness, strength loss and fly generation [9,10], Consequently, production of acceptable yarn is achieved only at relatively low speed. For spinning jute cotton blended yarns jute fibre is mixed with cotton. Due to some inherent properties of jute it creates some problems during spinning. Some important process variables influence the quality of the yarn. Spindle speed is the most important parameter deciding the ring frame production per spindle. The two key factors which determine spindle speeds are technological capability of ring frame and end breakage rate At very high spindle speeds yarn elongation and the number of thin places are also likely to be affected [11]. Mills have to pay special attention to ensure very high regularity levels at the preparatory departments through efficient blending and opening proper parameter selecting and material handling and high standard of machinery maintenance. With the advent of modem high speed ring frames spindle speed has increased phenomenally in the recent years. Yarn irregularity shows a trend of variation with increase in spindle speed. So spindle speed is one of the important factors which affect the yarn properties. The present study aims to investigate the effects of four different ring spinning spindle speeds on the quality of jute/cotton blended yarns produced, and there by ascertain the optimum spindle speed level for better yarn quality.

2. MATERIALS AND METHODS

2.1 Materials Jute: Jute namely variety: O-9897 was collected from Manikgonj station of BJRI. Bachh pat (immature jute) was collected from different districts of the country.

Cotton: Uzbekistan cotton was collected from different textile spinning mills of the country.

2.2 Methods

2.2.1 Cutting/ Stapling Of Raw Jute:

At first raw jute was cut into three main portions like top, middle and bottom manually and then these three portions were cut into 44 mm staple length by a cutting machine. Only middle portion of jute was used in our experiment

2.2.2 Chemical Modification:

Middle portion of the stapled jute fibers were first treated with 20 % NaOH solution at room temperature for 20 minutes. The fibres were hydro extracted to recover NaOH solution. They were then washed several times with water, neutralized with dilute sulhpuric acid and finally rinsed. The fibres were then bleached with Hydrogen peroxide (H_2O_2) (10% o.w.m) at a temperature of 85^0 C for 1 hour at pH of 10-10.5. These were then washed and dried.

2.2.3 Opening And Cleaning

Jute and cotton fibres contain various kinds of dirt, dust, leaf, foreign matters etc. On the other hand, both the fibres remain compact at initial stage. So it is necessary to open the fibre by breaking their net structure. An opener was used both for cotton and jute fibre for well opening and cleaning of the fibre by removing trash particles.

2.2.4 Blending

For improvement of functional properties, process performance and to reduce the mixing cost and get fancy effect it is necessary to blend jute cotton. After opening and cleaning, jute fibres were blended with cotton manually in the ratio of jute: cotton = 10: 90, 20: 80 and 30:70

2.2.5 Sliver & Yarn Preparation

The blended material was then fed in a scutcher machine for the preparation of lap. This lap was then fed in a carding machine for the preparation of sliver. This sliver was feed into a drawing frame. This drawing frame was having 4 over 4 drafting system. In the drawing frame doubling and drafting operations were applied on the sliver. This sliver was fed in the roving frame. Then roving was feed in the ring frame. Finally, yarn is wound into a bobbin.

3. RESULTS

During the research period variety O-9897 jute fibres were collected from Manikgonj station of BJRI. Two important physical properties (strength and fineness) of the collected fibres were measured. All physical properties of produced yarns were also measured. The results are furnished in Table 1, Table 2, Table 3 and Table 4.

Table 1: Fiber strength and fineness of middle portion jute fiber before chemical treatment.

Variety	Fibre strength: Pressly Index (lbs/mg)		Fineness/ Diameter (μ)
O-9897	Middle		Middle
	Avg	10.91	24.3
	C.V%	13.85	9.08

Table 2: Fiber strength and fineness of middle portion jute fiber after chemical treatment.

Varieties	Fibre strength: Pressly Index (lbs/mg)		Fineness/ Diameter (μ)
O-9897	Statistics	Middle	Middle
	Avg	10.15	23.12
	CV%	11.43	7.97

Table 3: Physical Properties of Jute-Cotton Blended Yarn

Blend Ratio J : C	S.S (rpm)	Tenacity (cN/tex)	B.E (%)	Uneveness (%)
10:90	8000	15.56	7.68	14.00
	8500	15.45	7.54	13.90
	9000	15.85	6.48	15.45
	9500	16.12	6.24	16.24
20:80	8000	12.15	6.12	17.25
	8500	11.70	6.00	17.64
	9000	13.20	5.74	17.88
	9500	12.84	5.66	18.00
30:70	8000	10.80	5.65	22.32
	8500	11.10	4.88	23.64
	9000	9.85	4.40	23.88
	9500	9.05	4.00	24.00

Table 4: Physical Properties of Jute-Cotton Blended Yarn.

Blend Ratio J : C	T.P/km (+50%)	Th.P/km (-50%)	Neps/km (+200%)	Total Imperfections	Hairniss (H)
10:90	412	210	250	872	7.80
	395	205	290	890	8.24
	468	274	320	1062	8.45
	500	300	350	1150	9.24
20:80	566	556	547	1669	9.12
	680	546	658	1884	9.60
	745	653	759	2157	10.12
	800	748	821	2369	10.90
30:70	1815	1335	1495	4645	9.42
	1902	1388	1370	4660	10.53
	1988	1412	1250	4650	11.87
	2012	1506	1201	4719	12.25

4. DISCUSSION

Jute and cotton fibres are completely different in nature and in their physical properties. So jute fibres were chemically treated to make them soft and improve interfibre cohesion so as to make them suitable and compatible for blending with opened cotton. From Table 1 and Table 2 it was seen that strength loss of the middle portion 6.69% and diameter decreases 4.85 %.

4.1 Effects of Spindle Speed on Yarn Tenacity

Jute and cotton fibres are completely different and natural and in their physical properties. So jute fibres chemically treated to make them soft and improve inter fibre cohesion so as to make them suitable and compatible for blending with opened cotton. From Table 3 it is in seen that spindle speed increases, the tenacity of jute/cotton blended yarn also increases when jute content in the increases tenacity decreases.

4.2 Effect of Spindle Speed on Unevenness and Imperfections

Unevenness and imperfections of jute–cotton bended spun yarn at various spindle speed are illustrated in Table 3 and 4. From table it is observed that U%, think

places, thin places and total imperfections per kilometers showed a trend to increase with spindle speed.

4.3 Effects of Spindle Speed on Yarn Hairiness

From table 4 it is found that when spindle speed increases the hairiness of jute cotton blended yarn increases. This is due to fact that at higher spindle speed the number of floating fibre increases and the fibre tend to protrude from the body of the yarn and hence yarn hairiness increases.

4.4 Effects of Spindle Speed on Breaking Extension

From table 3 it is found that when breaking extension of jute cotton blended yarn decrease as the spindle speed increase. When percentage of jute content in the blend increase the breaking extension decreases.

5. CONCLUSION

Jute / Cotton blended yarns have high hairiness, imperfection and irregularity at higher spindle speed. With higher percentage in the blend the yarn has low breaking extension in higher spindle speed. Jute / Cotton (10:90) blended yarn yields higher strength and is more uniform than yarn produced from 20:80 and 30:70 jute / cotton blended yarn with increased spindle speed.

6. REFERENCES

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7. NOMENCLATURE

Symbol	Meaning
S.L	Staple Length,
L.D.	Linear Density,
F	Fineness
S.S.	Spindle speed
B.E.	Breaking Extension
T.P	Thick places
Th. P	Thin Places
T.I.	Total Imperfections
U%	Unevenness percentages
J	Jute
C	Cotton

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