

Enhancing the dependence of blended jute yarn rather than hundred percent cotton yarn

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Abstract

Blending is a mixing process where two or more different fibers are combined into the desired percentage. In a yarn spinning system, different compositions, lengths, diameters, or colors may be mixed to create a blended yarn. In this system, various lots of fibers are combined into a homogeneous mass before being spun into a staple fiber yarn. Usually, jute and cotton fiber are blended together to make jute-cotton blended yarn. The diversified use of jute is one way to blend yarn. A 30%: 40%: 30% ratio was used for making the jute-cotton-viscose blended yarn. A rotor frame in a cotton spinning line produced the jute-cotton-viscose blended yarn and 100% cotton yarn. The physical properties like count, yarn Lea strength, and CSP were measured for both jute-cotton-viscose blended yarn and 100% cotton yarn. Among them, the average count of jute-cotton-viscose blended yarn and 100% cotton yarn are found approximately the same, i.e., 6.0 and 5.89, respectively. However, the yarn lea strength and CSP of both samples are 318.6 lb, 208 lb, and 1876, 1246, respectively, for 100% cotton yarn and jute-cotton-viscose blended yarn, which are far different from each other. There is the consistency of CV%, SD, and PMD of the blended yarn as well as 100 % yarn. In this study, viscose was first introduced for the blending process with jute and cotton to produce a jute-cotton-viscose blended yarn, and the physical properties were compared with both yarns.

Keywords: Jute; Cotton; Viscose; Rotor; Blending

1. Introduction

Jute is a high-modulus, coarse, rough, abundantly available brown color, fibre and cotton is a cool, soft, comfortable, seed fibre whereas, viscose is a low-modulus, fine, white, smooth, lustrous, bastfibre [1]. Cotton is the principle clothing fibre and it is very familiar in the world too [2]. On the other hand, viscose is a regenerated cellulose fibre, which is directly spun from cellulose. It is easily understandable to see the manufacturing process of viscose. Where cellulose is mixed with the highly concentrated of sodium hydroxide for making soda cellulose, this soda cellulose treats with carbon disulfide to produce sodium cellulose xanthate. Finally, the sulphuric acid solution is applied to the sodium cellulose xanthate to produce regenerated cellulose. Therefore, it is called regenerated fibre [3]. End of the eighteenth-century viscose was discovered but Courtaulds first produced it commercially in 1905 as an affordable alternative to natural silk. This synthetic filament or staple fibre is comparatively more expensive than that of the jute and cotton

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fibre. Normally viscose is synthesized from cotton linter or spruce and pine trees pulp and used as a versatile fabric, often known as artificial silk, which is found in jacket linings, T-shirts, active wear, fashionable dresses and tunics. To produce the final product as viscose fabric, the wood cellulose goes through several critical steps, which are expensive. On the other hand, jute is cheap and abundantly available in Bangladesh [4]. Only traditional uses of jute such as charcoal, activated carbon, ropes, sacking, hessian, and Carpet Backing Cloth (CBC) remain, and these are dwindling as cheap synthetic materials make inroads [5,6]. Nowadays, it is the time of the industrial revolution, but the public is concerned about the environment. Focusing on both topics, jute is the best fibre for diversified uses, and for that reason, the use of jute is increasing over synthetic. Blending is a very important technology for the diversified application of jute products. Many authors studied different modes of action of blending by the different fibers [7-12]. Cumming and Atkinson reviewed methods of blending viscose staple fiber with jute fiber and examined some qualitatively average properties of the resulting products [13]. A lot of blended yarns, among them jute-cotton and jute-viscose blending, were studied by Debnath and Bandyopadhyay [1]. Bhardwaj and Juneja investigated some optimum conditions for the performance of jute, viscose/polyester, and cotton blending yarns used in apparel [2]. Silky, luster, high tensile strength, low extensibilities, considerable heat, and fire resistance are the important characteristics of jute fibre. Jute is blended with other textile fibres like cotton and viscose to make blended yarns because those textile fibres are more expensive and lack availability [14,15]. Alternatively, jute has a great abundance and is cheap. After blending jute with other textile fibre, manufactured yarns become lower priced [16-18]. Blending jute with other textile fibers is one of the most valuable diversification techniques for manufacturing yarns. Viscose and cotton are both more expensive than jute and are almost imported from abroad. The import quantity of viscose and cotton is increasing surprisingly day by day in Bangladesh, such as 40278 tons, 53289 tons, and 53474 tons, respectively [19]. Therefore, it is time to reduce the use of foreign fibre and increase native fibre like jute. In this regard, we have first time manufactured jute-cotton-viscose blended yarn in a cotton spinning system. In this blended yarn, 30% jute, 40% cotton, and 30% viscose were used. As a result, a new variety of jute cotton and viscose blended will be developed and the consumption of jute will be increased as well as the import of cotton and viscose will be reduced. Besides this, the characteristics of blended yarn could be customized with different blend compositions and developed the properties of jute, cotton, and viscose blended yarn for specific end-use. The target of our research is to produce jute cotton and viscose blended yarn that could replace the valuable cotton and viscose fibre, which will save foreign currency. Here, we have focused to prepare the jute-cotton-viscose blended yarn (Figure1) and compared the properties of the jute-cotton-viscose blended yarn with those of a hundred percent cotton rotor yarn besides that it was also observed the blended yarn properties how much closer to 100% cotton.

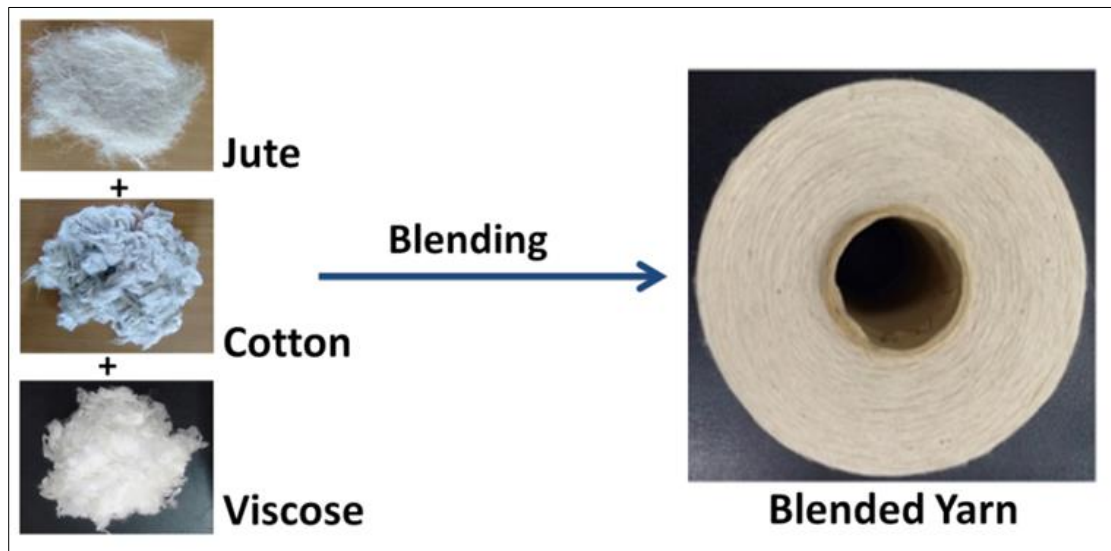


Figure 1 Preparation of Jute-Cotton-Viscose blended yarn

2. Material and methods

2.1. Materials

Jute fibre and cotton were collected from a local source in Bangladesh and viscose was imported from China. Jute fibre was cut by the fibre cutting machine. All the chemicals are used in commercial grades, such as caustic soda, detergent, sodium silicate, hydrogen peroxide, acetic acid, and silicon purchased from the local market. The research was

conducted in the laboratory of the Jute Textile Research Wing, Bangladesh Jute Research Institute (BJRI), Dhaka, Bangladesh.

2.2. Methods

Jute fibre was cut into 33-35mm pieces by a fibre cutting machine. Chemical modification was done under standard conditions. Cut jute fibres were treated with the following chemicals: caustic soda, detergent, sodium silicate, hydrogen peroxide, acetic acid, and silicon softener, respectively. The dried jute fibre was opened three times by the fibre opening machine. Then, jute, cotton, and viscose were blended with a certain ratio of 30%, 40% and 30%, respectively. Jute-cotton-viscose blended fibre was being spun by rotor frame to produce jute-cotton-viscose blended yarns. 100% cotton yarn was also produced by the same spinning system. Lea of 120 yards of yarn was prepared by wrap reel and balance. The count was measured by reep reel and balance method and Lea's strength of yarn was determined by Goodbrand & Co. Ltd. Machine.

3. Results and discussion

Jute, cotton, and viscose fiber are all very different in terms of nature and other properties. Therefore, it is extremely difficult to spin all of it together on a spinning machine. To overcome the major problem, a little chemical modification and mechanical processing are needed, along with needed correction of process parameters and proper raw material selection too [19-21]. Therefore, the jute, cotton and viscose were blended with a certain ratio of 30%, 40% and 30%, respectively, and were spun by rotor frame to produce jute-cotton-viscose blended yarns. Figure 2 demonstrated the entire blending process of jute-cotton- viscose blended yarn.



Figure 2 Flow chart diagram of blending process

In both, 100% cotton yarn and jute cotton viscose blended yarn's Lea (120yds) strength was used for count measuring in an indirect system with reep reel and balance method. The test results of both Standard Deviation (SD) and Percentage of Mean Deviation (PMD) are given in Table1. The average count of 100% cotton and jute cotton viscose blended yarn is 5.89 and 6 respectively, which is very close to each other. The SD of Jute-cotton-viscose blended yarn

and 100% cotton yarn count are 0.076 and 0.037 whereas the PMD of both yarns are 1.02 and 0.5029. Both value SD and PMD of Jute-cotton-viscose blended yarn count are twice than 100% cotton yarn count. On the other hand, better that is within the standard level and nearer to each other. Lea strength and Count Strength Product (CSP) of Jute-cotton-viscose blended rotor yarn's SD and PMD are 2.853 and 44.416 whereas the Lea strength and CSP of 100% cotton rotor yarn's SD and PMD are 1.628 and 38.184.

Table 1 Comparison of jute-cotton-viscose blended yarn and 100% cotton yarn

Sample Name	SD	PMD
Jute-cotton-viscose blended yarn	0.076	1.02
100% cotton yarn count	0.037	0.5029
Lea strength and CSP of jute-cotton-viscose blended rotor yarn	2.853	44.416
Lea strength and CSP of 100% cotton rotor yarn	1.628	38.184

According to certain studies, yarn with a CSP value of 1400 or less is not good or strong, whereas yarn with a CSP value of 1400 to 1800 is average, and yarn with a CSP value of greater than 2200 is strong. Table 2 compares 100% cotton and blended yarns for Lea strength Coefficient of Variation% (CV) percent and CSP. According to our trial, 100% cotton and blended yarn have an average CSP value of 1876, which is higher than blended rotor yarn made of jute, cotton, and viscose (1245.6)

Table 2 Lea strength and CSP comparison of 100% cotton and blended yarn

	Sl.No.	Lea wt. in gm	Lea strength of yarn (lb)	CSP	CV(%)
100% cotton rotor yarn	1	10.96	310	1832	2.035
	2	10.92	315	1868	
	3	11.05	330	1934	
	4	10.98	320	1888	
	5	11.09	318	1858	
Jute-cotton-viscose blended rotor yarn	1	10.703	200	1200	3.566
	2	11.057	212	1272	
	3	10.737	218	1308	
	4	10.759	202	1212	
	5	10.856	206	1236	

The coefficient of variation [CV% (standard deviation/average) x 100] is the statistical analysis of the yarn samples. The coefficient of variation normally defines the number of variations within the yarn structure. Depending to table 2, the CV% of 100% cotton and blended yarn are 2.035 and 3.566. These results indicate that jute-cotton-viscose blended rotor yarn is nearly close to the 100% cotton rotor yarn. Figure 3 shows the average count (Ne) versus CV%, average Lea strength (lb) versus CV%, and average CSP versus CV% of 100% cotton yarn and jute-cotton-viscose blended yarn. The average count (Ne) of 100% cotton yarn and the jute-cotton-viscose blended yarn is 5.89 and 6.0, with a CV% of 0.6286 and 1.275. These results indicate that the CV% of the jute-cotton-viscose blended yarn is close to that of 100% cotton yarn. Therefore, newly developed jute-cotton-viscose blended yarn is regular.

The average Lea strength of 100% cotton yarn and the jute-cotton-viscose blended yarn is 318.6 lb and 208 lb, with a CV% of 2.32 and 3.56. Instead of the average Lea strength, the CV% of both yarns is similar. That means the strength variation of both yarns is in an acceptable range. The average CSP of 100% cotton yarn and the jute-cotton-viscose blended yarn are 1876 and 1246, with a CV% of 2.035 and 3.566. However, the CSP value is little bit difference but the CV% is nearly close, accordingly the quality of the blended yarn is as much as good compared to 100% cotton yarn.

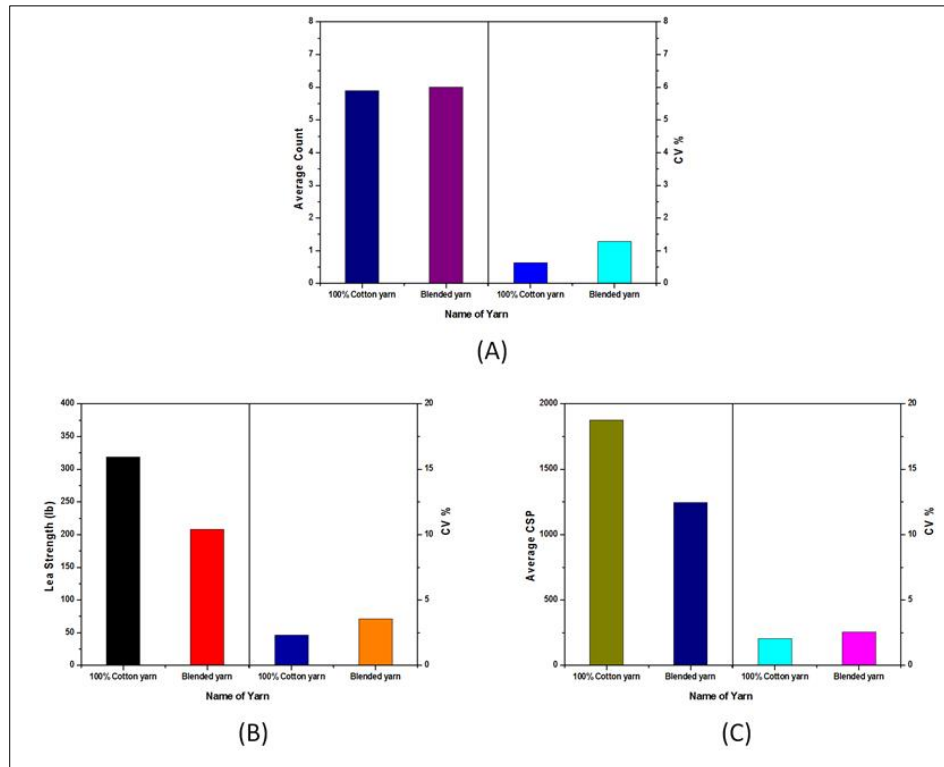


Figure 3 (A) Average count with CV(%), (B) Average lea strength with CV(%), (C) Average CSP with CV(%); the difference between 100% cotton yarn and jute cotton viscose blended yarn

4. Conclusion

Jute-cotton-viscose blended yarn is prepared by the simple process of blending from 30%, 40% and 30% ratios of jute cotton and viscose, and a rotor frame in a cotton spinning line was used for the diversified application of jute-blended products. The physical properties like count, Lea strength and CSP were measured for both jute-cotton-viscose blended yarn and 100% cotton yarn and were relatively studied. The average count of jute-cotton-viscose blended yarn and 100% cotton yarn is approximately the same. However, the yarn lea strength and CSP of both samples are a little bit dissimilar from each other. Both yarns are consistent in terms of CV%, SD and PMD. Viscose is a man-made fibre. It is difficult to spin with natural fibre. Some limitations are also observed during mechanical processing, such as slipping of a sliver in a speed frame and untwisting of a sliver. Despite the limitation, all the physical properties of jute, cotton, and viscose blended yarn are up to the mark. If correct raw material selection and proper dosing of chemical and mechanical processing are maintained, it is expected that the quality of blended yarn will be improved. More research is needed to create a low-cost, fashionable textile product from jute-cotton-viscose blended yarn for the domestic and international markets.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors declare that they have no conflict of interest.

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