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Analysis of the Physico-Mechanical Properties of Jute Polypropylene Blended Yarn

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Abstract

Bangla white D (BWD) grade jute fiber and Polypropylene of linear density 6 denier were blended at 60:40, 70:30; 80:20 and 100% jute yarn of 8lbs/spyndle were produced. Mixing of softened jute fiber and tufts of polypropylene were blended at feed sheet of the Breaker card machine. Changes in yarn characteristics have been studied at different blend ratio of jute and polypropylene. It is observed that the property of blended yarn is better for increasing the percentage of Polypropylene. Blended yarn become stronger, increase Elongation% and lower end breakage rate and more quality ratio compare with 100% jute yarn. Variation of Twist CV% increases remarkably for increasing the percentage of polypropylene and shows an increasing trend with the percentage of polypropylene up to 40%. Tested results are also justified with the help of Statistical Package for Social Science (SPSS).

Keywords: Jute, Polypropylene, Blended yarn, Yarn properties, SPSS.

"1. Introduction"

Jute is a natural cellulosic bast fiber. It is a textile fiber of good spinnable character. Jute fiber shows low extensibility due to its 'composite-like' structure with highly oriented long chain molecules. Some noted disadvantages include poor drapability and crease resistance, brittleness, fiber shedding and yellowing in sunlight. Jute yarns especially the finer ones exhibit higher irregularity as compared to cotton or wool yarns [1]. At present there are large numbers of man-made fiber in the world textile market. Jute fiber has been facing a tough competition with man-made fiber since its emergence in the world textile market. To overcome this competition it is necessary to produce different diversified jute goods by using jute and jute blended yarn as well as improving the productivity. On the other hand Polypropylene(PP) has higher abrasion resistant, colorfastness, low static, thermally bondable, stain and soil resistant, strong, sunlight resistant, very comfortable and very light weight. This has been particularly helpful in the development of jute polypropylene blended blankets, upholstery, and carpet and apparel fabrics [2].

The conventional jute products are facing tough competition with synthetics in the world market. Industries are gradually losing their productivity and very reasonably less effort are given to improve the productivity. The study was designed to compare the different blend ratio of jute-polypropylene blended yarn. So, blended yarns can be used as raw materials for production of diversified and value added jute products. There is a prospective market for jute and jute blended yarn in the world. The produced yarn will be used in furnishing fabric, decorative fabric, shopping bag etc. As a result, diversified uses of jute will be increased. So, it is most essential to produce jute blended yarn by the existing machine through an extensive study. Therefore, the aim of this study was taken to produce jute-polypropylene blended yarn.

"2. Materials and Method"

Collection of PP fiber of 6 linear density and BWD grade jute fiber has been taken by weight according to Jute: PP (80:20),Jute : PP (70:30),Jute : PP (60:40) blend ratio &100% jute fiber. There are various methods of jute spinning. The experimental work was carried out by conventional jute spinning system. At first the PP fibers were separated and opened up manually by hand teasing and tufts of certain weights were made. After that the blending was carried out by spreading the component fibers i.e. jute and polypropylene fibers in desired proportion by weight over the breaker card feed lattice. . Manufacture of 8 lbs/spyndle jute yarn according to long staple spinning system [3]. Compare the different quality parameters of Jute-PP blend yarn and statistical ANOVA analysis.

In this Study SPSS used for data analysis. SPSS is the acronym of Statistical Package for the Social Science. **SPSS** is one of the most popular statistical packages which can perform highly complex data manipulation and analysis with simple instructions. It is designed for both interactive and non-interactive (batch) uses.

SPSS is a Windows based program that can be used to perform data entry and analysis and to create tables and graphs. SPSS is capable of handling large amounts of data and can perform all of the analyses covered in the text and much more. SPSS is commonly used in the Social Sciences and in the business world, so familiarity with this program should serve you well in the future [4].

One-Way ANOVA:

The ANOVA is a statistical technique which compares different sources of variance within a data set. The purpose of the comparison is to determine if significant differences exist between two or more groups .The one-way analysis of variance (ANOVA) is used to determine whether there are any significant differences between the means of three or more independent (unrelated) groups [5].

In the study, 100% Bangla White D (Pucca grade) fiber was selected from the local market and following properties were observed:

i) Color: white
ii) Average length of reeds: 8 feet
iii) Average strength: 31.28 g/tex (1/8 inch gauge length)
iv) Bark and specks were visible
v) Root cut: Clean and free from croppy or hard gummy (croppy: harsh top end in the fiber bundle)
vi) Average lustre was visible and no red ends were visible

Quality parameters of polypropylene was Length 64 mm, Fineness 6 Denier, Tensile strength >3.5 CN/dtex and Elongation % 40$\pm$20

Table1. Preparation of Jute fiber morah and PP tufts

Blend ratio (Jute : PP)	Amount of Jute and PP	No. of Morah	Weight of each Morah	No. of tufts	Weight of each tufts
70 : 30	Jute : 17.5 Kg PP : 7.5 Kg	36	486.11 gm	18	416.66 gm
80 : 20	Jute : 24 Kg PP : 6 Kg	48	500 gm	24	250 gm
60: 40	Jute : 13.62 Kg PP : 9.07 Kg	40	340.2 gm	20	453.6 gm
100% Jute	Jute : 30 Kg	15	500 gm	×	×

Table2. Apron draft spinning parameters

Blend Ratio	3rd Draw Frame (lbs/100 yds	Count (lbs/spyndle)	Draft	DCP	TCP	Twist Constant	TPM	Spindle Speed RPM
Jute: PP (80:20)	0.7215	8	12.72	59	41	5906	144.08	3200
Jute: PP (70:30)	0.862		15.20	50				
Jute: PP (60:40)	0.856		15.09	50				
100% Jute	0.625		11.00	69				

"3.Result and Discussion"

Analysis of Microscopic Appearance

Under the microscope, the jute fiber looks like cross wise marks called nodes or joints. And Polypropylene very regular, rod like appearance. From the above figure it is clearly shown that with the increase of the portion of polypropylene cross wise marks decrease and rod like appearance increase gradually.

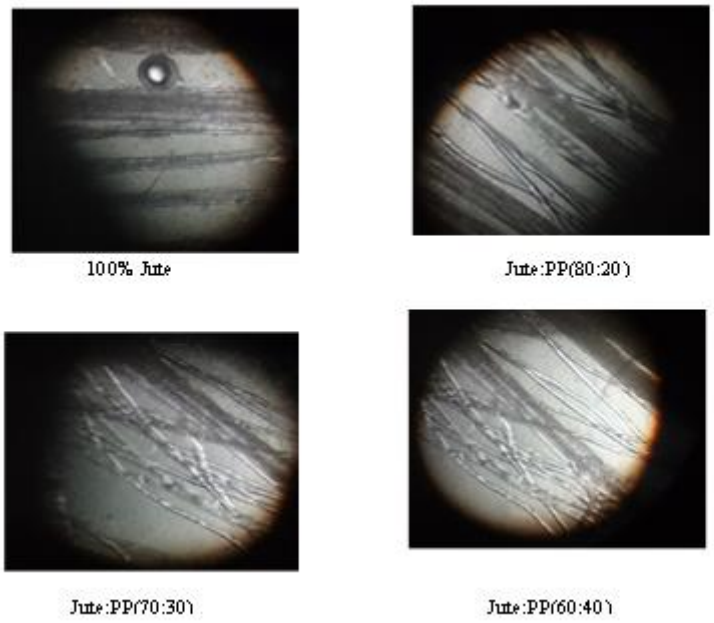

Fig.1. Longitudinal views of yarn

Analysis of Yarn Count

Jute yarn count is expressed by lbs/spyndle. The yarn number or count in the lbs/spyndle system is the weight in lbs of 14400 yds. Wrap reel is used to prepare the sample of length 100 yds. For this research work average yarn count is calculated from 10 samples [6].

Table3. Comparative yarn count analysis on different blend ratio

Blend Ratio (Jute:PP)	Avg. Count (lbs/spyndle)	SD	Count CVt%
100% Jute	8.11	0.41	5.02
80:20	8.59	0.53	6.21
70:30	8.45	0.60	7.15
60:40	8.16	0.50	6.14

The table3. Show the co-efficient of variation of count against different blend ratio of jute and polypropylene. As observed, except 60:40 blend ratio Count CVt increase with the increase of the portion of PP. According to the result in case of 100% jute count CVt decline from around 5.02 to just over 6.21 in 80:20 blend ratio. However, it went up again a little in 70:30 blend ratio around 7.15. From the test result Count CVt slightly decrease against 70:30 blend ratio around 6.14. In short, count CVt% was becoming more with the increase the proportion of polypropylene.

Analysis of Strength and Elongation

From Table.4 it is clearly observed that Strength of blended yarn increase gradually with the increase of polypropylene portion. Strength is one of the most important characteristics to determine the quality of jute yarn. It may be the reason of Polypropylene fiber strength. The Strength of polypropylene is more than jute fiber. It could be the reason with the increase the portion of polypropylene blended yarn shows higher strength.

Table4. Comparative strength and Elongation% on different blend ratio

Blend ratio (Jute:PP)	Average load at break (kg)	Strength CV%	Extension at break(Avg.) (cm)	Avg. Elongation%
100% Jute	2.75	10.32	1.69	3.38
80:20	2.99	10.27	1.81	3.62
70:30	3.13	8.52	2.16	4.32
60:40	3.18	6.07	2.19	4.34

Quality ratio analysis

It is an expression of jute yarn strength, expressed as

$$QR = \frac{Average\ breaking\ load\ (lb)}{Grist\ (lbs/spy)} \times 100$$

Average result is calculated from 10 samples of different blend ratio yarn [7].

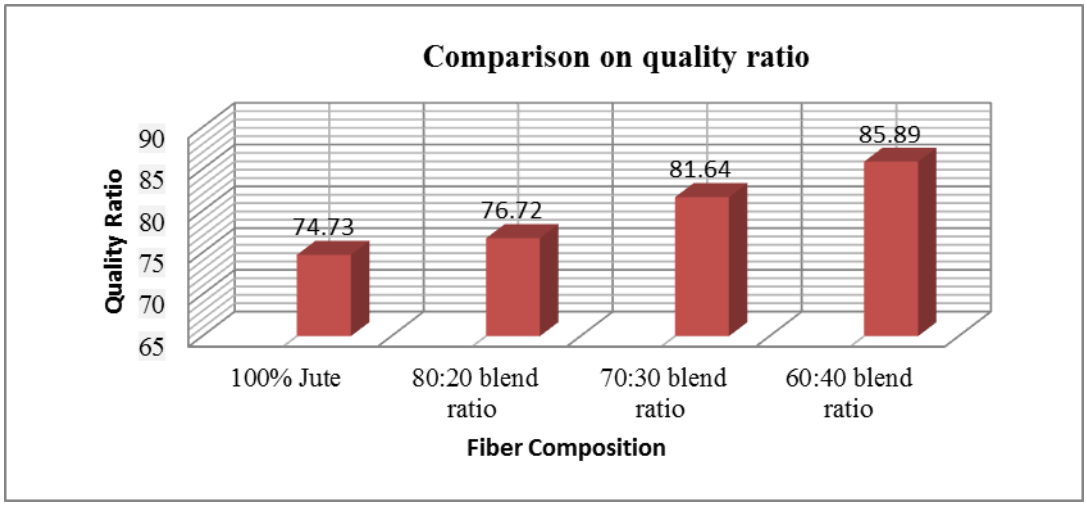

Fig.2. Quality ratio for different blend yarn

Quality ratio is an expression of jute yarn strength. It is the important parameters of jute yarn quality. The Fig. 4.7 shows the quality ratio of different fiber composition. As is observed here, lower the PP fiber, lower the quality ratio of that yarn.

Analysis of twist

Table 5. Comparative study of twist and twist CV% on different blend ratio

Blend ratio (Jute:PP)	Average Twist per inch (TPI)	SD	Twist CV%
100% Jute	3.58	0.078	2.20
80:20	3.52	0.010	2.93
70:30	3.85	0.143	3.72
60:40	3.76	0.183	4.88

The Table 5 shows the co-efficient of variation of twist against different blend ratio of jute and polypropylene. As observed, twist CVt increase with the increase of the portion of PP. According to the result in case of 100% jute count CVt decline from around 2.29 to just over 2.93 in 80:20 blend ratio. However, it went up again a little in 70:30 blend ratio around 3.72. From the test result Count CVt increase 70:30 blend ratio around 4.88. In short, twist CVt were becoming more with the increase the proportion of polypropylene.

Statistical analysis (ANOVA) for Breaking Strength

In this study, four types of blend ratio yarn are taken for comparison strength. Statistical One way ANOVA test was employed for doing this comparison.From Anova table 6 for different blend ratio the significance value (P-value): .004 is less than alpha (.05) value, thus null hypothesis is rejected.

The null hypothesis is rejected for different blend ratio, which means there is significant difference between different blend ratio yarn strength

Table 6. ANOVA for Breaking Strength

	Sum of Squares	Df	Mean Square	F	Significance
Between Groups	1.113	3	.371	5.234	0.004
Within Groups	2.551	36	.071		
Total	3.664	39			

"4. Conclusion"

Jute is called the golden fiber of Bangladesh. Raw materials represent one of the top manufacturing costs of spinning system. This fact alone is sufficient to show significance of raw materials. Locally produced jute and thereby jute products can save foreign currency. The global textile market is dominated by man-made fibers, as result jute, as a natural fiber, is facing a tough competition with man- made fiber since it emergence in the world textile market. To overcome this competition it is necessary to produce different diversified jute goods by using jute and jute blended yarn as well as improving the productivity. The development of different diversified jute products, using jute alone or in combination with other fibers is need to large. Jute and polypropylene blend is one step ahead of diversified jute products. This study has investigated yarn characteristics with different blend ratio. The count CVt% is little bit higher of jute -PP blended yarn compare to100% jute yarn. This variation is due to lacking of proper maintenance of jute manufacturing machinery. Twist CV% increase significantly for increase PP in yarn. The frictional properties of PP may be responsible for this. It is also found that with the increase the of PP% the breaking strength and elongation increase remarkably. Low extensibility is a drawback of jute yarn, but jute blends with PP shows better extensibility. This study found that Quality ratio of different blend ratio (Jute: PP) 60:40, 70:30, 80:20 and 100% jute yarn respectively 85.89, 81.64, 76.72 and 74.73 which express the overall strength of the blend yarn. From ANOVA it appears that the result of twist and breaking strength are found positive. All the findings suggest that jute polypropylene blended yarn will be helpful in the development of innovative blankets, upholstery, carpet and different technical textiles.

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