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Study on the Characteristics of Jute-Cotton Blended Fabrics

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Abstract

Jute manufacturing sector is one of the oldest traditional manufacturing sectors of Bangladesh. As a ligno-cellulosic bast fiber jute possesses hard and harsh qualities, which make it difficult to produce apparel and other fancy fabrics to use in our day to day life. Jute-Cotton blend is one of the possible options to reduce the dependability on the cotton. The aim of this work is to characterize the Jute-cotton blended fabric. In this work 2/1 and 3/1 twill fabrics have been produced with Jute-cotton blended yarn at two different ratios, e g. 50:50 and 30:70 respectively. A detailed analysis of both fabric samples such as weave design, yarn count, fabric density, cover factor, weight per unit area (g/m^2), fabric strength, dyeing performances such as wash and rubbing fastness have been evaluated. The Reflectance % and color strength K/S values of reactive dyed fabric and indigo dyed warp yarn fabric samples were also studied. The experimental works have been done at Hoor-e-Shams Composite Textile Mills Ltd., Southeast university and R. H Corporation (CHT Bezema) in Bangladesh.

Keywords: *Jute-Cotton blended fabric, fabric density, cover factor, weight per unit area (g/m2)*

I. Introduction

Jute fiber is a bast fiber obtained from the bark of jute plant containing three main categories of chemical compounds namely cellulose (58~63%), hemi-cellulose (20~24%) and lignin (12~15%), and some other small quantities of constituents like fats, pectin, aqueous extract. Jute fiber is composed of small units of cellulose surrounded and cemented together by lignin and hemi-cellulose (Pan *et al.*, 1999). Jute fiber conventionally is not used for producing wearable textile products as it has some shortcoming in regard to feel, stiffness, drape, coarseness, wash ability and abrasion (Azad *et al.*, 2009). Now a days, in jute sector, demand of diversified jute uses and improved quality is increasing for the use in different areas namely floor coverings, household textiles, technical textiles, handicrafts, etc. (Sengupta *et al.*, 2012). Blending is a technique to overcome the poor characteristics of one fiber. It is the technique to combine fibers which emphasizes the good qualities and minimizes poor qualities of the fibers. It also makes the fabric manufacturing process economical. Jute-cotton blended yarn is one of the examples of it (Bhardwaj *et al.*, 2012). Blending jute with cotton fiber may be an acceptable way of jute diversification by which value added products can be produced. Jute fibers have several advantages like a lustrous golden appearance, high tenacity and good properties. Hence the techniques of blending and softening could as utilized to upgrade the quality of jute and thus form a new class of jute-based fabrics having an expanding market within and outside the country (Shilpa *et al.*, 2007).

In the present work, a few characteristics of jute-cotton blended fabrics have been evaluated. Fabric produced from the blended yarn might have better characteristics than what could be obtained in a fabric produced from a single fiber. The blending of cotton is done to develop drape properties,

comfortability, durability, dyeability and many other properties of the fabric products. Any successful attempt to blend jute fiber with cotton would be a break-through in the field of textile (Salam *et al.*, 2007). The use of fabrics made from Jute-Cotton blended yarns would surely strength our economy by cutting a part of the cost incurred for importing cotton and enhancing the value addition due to locally produced cheaper jute as a raw material (Ahmedullah *et al.*, 2012).

II. Materials and Methods

Preparation of fabrics

The 2/1 twill woven fabric sample was prepared in Rapier loom using 50:50 jute- cotton blended yarn 20 Ne in warp and 16 Ne in weft. The ends/inch was 98

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and picks/inch was 54. The fabric sample was dyed with reactive dye.

The 3/1 twill woven fabric was also prepared in similar type of loom using 30:70 jute-cotton blended yarn 10 Ne in warp and 16 Ne in weft direction. The ends/inch was 70 and Picks/inch was 45. The warp yarn of the fabric sample was dyed with indigo dyes.

Weight per Unit Area

Gram per square meter (G.S.M) of both fabrics was calculated with the relationship

$$\text{G.S.M} = \left[\frac{\text{EPI}}{\text{Warp count Ne}} + \frac{\text{PPI}}{\text{Weft count Ne}}\right] \times$$

25.64, Where EPI indicates Ends per inch and PPI indicates Picks per inch of the fabrics

Cloth cover

The cloth cover describes the fabric construction showing to what extent the warp and the weft yarns are closely woven and was obtained from the relationship.

$K_c = K_1 + K_2 - K_1K_2 /28$

Where, K_c = Cloth cover

K_1 = Warp cover factor

K_2 = Weft cover factor

The fraction of space per inch of cloth covered by warp yarn is known as warp cover factor which was obtained as

$$K = \frac{\text{Threads per inch}}{\sqrt{\text{Count}}} = \frac{n}{\sqrt{Ne}}$$

similarly, the weft cover factor was calculated. The threads per inch n was counted with the help of thread counter

Strength Evaluation

The Force-Elongation curve of the fabric samples were determined by Universal Tensile Strength Tester GESTER (GT-CO2) at 300 mm/min test speed. The fabric samples were 15 cm x 10 cm attached with the upper clamp and lower clamp and the samples were tested with the mentioned speed.

Wash Fastness

The color fastness to wash of a dyed fabric is the measure of its resistance to fading, or color change, on exposure to a given agency or treatment. For both fabrics ISO105 E04 method was followed.

Rubbing Fastness

Color fastness to rubbing means the resistance of color of dyed materials to rubbing. Rubbing fastness of both fabric samples were measured in ISO105 A03 method.

K/S Evaluation

The color depth of the dyed fabrics was analyzed by measuring the K/S values of samples. Color measuring instrument Spectrophotometer (Data color) determines the K/S value of fabrics through Kubelka-Munk equation as follows:

$$\frac{\text{K}}{\text{S}} = \frac{(1-\text{R})^2}{2\text{R}}$$

Where R = reflectance percentage, K = absorption co-efficient and S = scattering co-efficient of dyes. This value represents the attenuation ratio of light due to absorption and scattering is found based on reflectance.

III. Results and Discussions

Fabrics from the blended jute-cotton yarn

The details of the fabric samples prepared from the jute-cotton blended yarns have been shown in the Table 1. The twill weave structure was chosen for fabric construction from jute-cotton blended fiber, because normally denim fabrics are of twill structural pattern. From the Table 1, it was seen that each fabric was woven with maintaining optimum spacing in the intersection of the yarns. The variations in the number of threads per unit length of fabric is in correspondence to the yarn count Ne, but the cover factors for both warp and weft and their resulting effect on the fabric was maintained almost identical. The fabric sample A was prepared with Jute-cotton blended yarn with ratio 50:50, 2/1 twill structured, warp yarn count was 20 and weft yarn count was 16, total no. of warp yarn and weft yarn per inch were 98 and 54 respectively, the cover factor was 24.85 and weight per unit area was 212 g/m^2. The fabric sample B was prepared with Jute-cotton blended yarn with ratio 30:70, 3/1 twill structured, warp yarn count was 10 and weft yarn count was 16, total no. of warp yarn and weft yarn per inch were 70 and 45 respectively, the cover factor was 24.50 and weight per unit area was 252 g/m^2.

Table 1: Fabric construction from jute-cotton blended yarns fabric

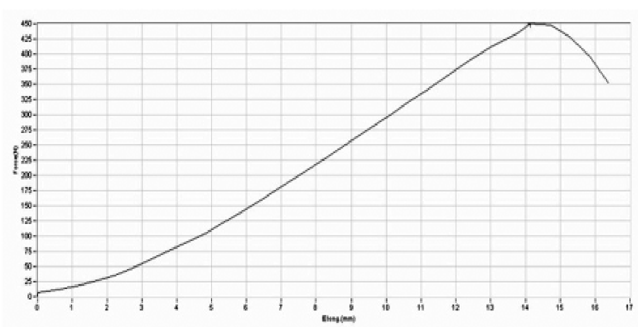
Fabric sample	Yarn composition (Blended ratio)	Weave design	Yarn count (Ne)	Threads per inch	Cover Factor	Weight g/m²
A	Jute:Cotton (50:50)	2/1 Twill	Warp 20 Weft 16	Ends 98 Picks 54	24.85	212
B	Jute:Cotton (30:70)	3/1 Twill	Warp 10 Weft 16	Ends 70 Picks 45	24.50	252

Strength Evaluation

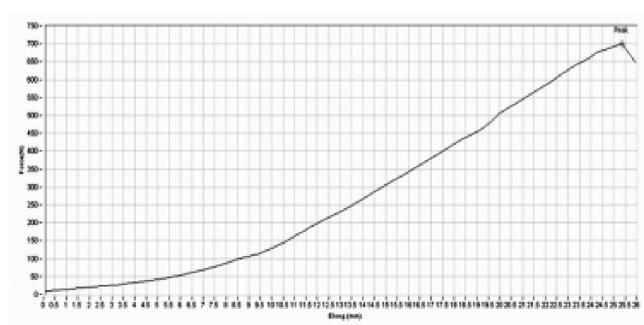
Table 2 shows the strength of jute-cotton blended fabrics. The Breaking forces of sample A and sample B are 449.863 and 700.593 Newton (N) respectively at 14.238 and 25.953 mm elongation. The elongation percentages are 9.492 and 17.302 for sample A and sample B. The data results have been shown graphically on figure 1 also. The X axis indicates the elongation in mm and Y axis indicates the breaking force in Newton (N).

Table 2: Strength test results of jute-cotton blended yarns fabric

Sample	Breaking Force (N)	Elongation at Break (mm)	Elongation percentage at break (%)	Breaking Strength (N)	Tensile strength (N/mm)
Sample-A	449.863	14.238	9.492	449.863	4.498
Sample -B	700.593	25.953	17.302	700.593	7.006



Sample -A



Sample -B

Figure 1: Force and Elongation curve of sample A and sample B

Wash Fastness

From the table 3 it was found that dyes stained on the fibers of the multifiber fabric show the rating is almost same for both the fabrics. The sample A was dyed with reactive dye and the warp yarn of the sample B was dyed with indigo dyes. The staining on the di-acetate, cotton, nylon, polyester, acrylic, wool for sample A and B was found in good rating value 3 to 4.

Table 3: Staining on the multifiber due to wash of different Jute-Cotton blended fabric.

Multifiber	Sample A	Sample B
Di-acetate	4	3
Cotton	3	3-4
Nylon	3	3
Polyester	4	3-4
Acrylic	4	4
Wool	4	4

Rubbing Fastness

From the table 4 it is seen that the dry rubbing fastness of sample A was better than sample B with the value 4 and 2-3 respectively. The wet rubbing fastness is also for sample A is better than sample B. The values are 2-3 and 1-2 respectively. As the sample A was dyed with reactive dyes and the warp yarn of sample B was dyed with indigo dyes, so, the rubbing fastness of sample A is better than the sample B.

Table 4: Rubbing fastness test result of Jute-cotton blended fabric.

Type of rubbing	Sample A	Sample B
Dry rubbing	4	2-3
	3-4	3-4
	3-4	2-3
Wet rubbing	2-3	2-3
	3	1-2
	2-3	2-3

Reflectance Evaluation

Figure 2 shows the reflectance (%) of sample A and sample B fabrics. It is known that, when reflectance is more, absorbance is less and when reflectance is less, absorbance is more. Reflectance (%) was measured in 400-450, 460-510, 520-570, 580-630, 640-690 and 700 nm wave lengths. For sample A, the reflectance % was 20, 18.36, 6.61, 4.0, 6.31, and 9.44 respectively. For sample B, the reflectance % was 6.26, 5.57, 4.49, 3.91, 4.79, and 5.65respectively.

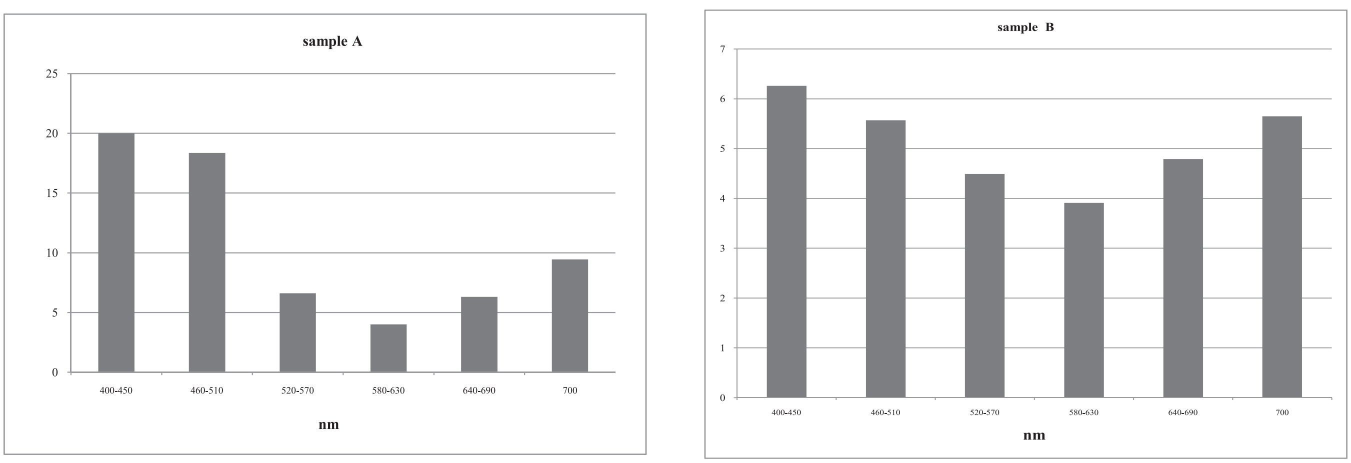
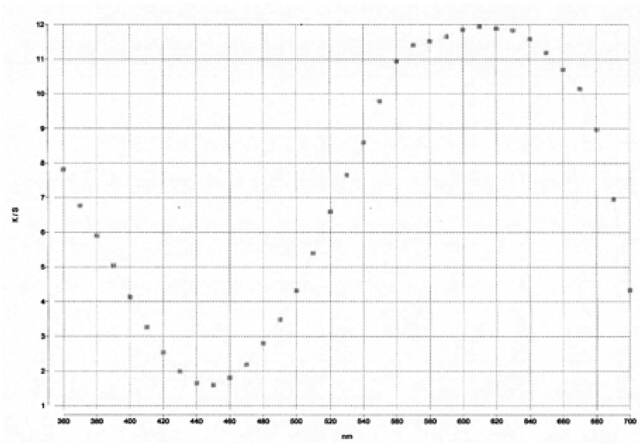


Figure 2: Reflectance % graph of sample A and sample B

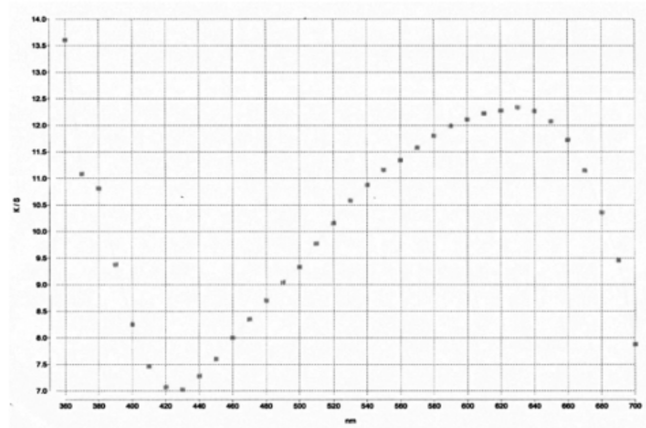
K/S Evaluation

Color strength of sample A and sample B was measured through K/S value and graphically represented in figure 3. When reflectance is more, absorbance is less which indicates the K/S value is less. On the other hand when reflectance is less; absorbance is more, indicates the more K/S value. K/S value was measured in 400-700 nm wave lengths. For sample A, the K/S value was lowest 1.6 at 450 nm and highest value was 11.93 at 610 nm. For sample B (warp yarn dyed with indigo) the

K/S was minimum 7.01 at 430 nm and maximum 12.35 at 630 nm wave lengths.



K/S graph of sample-A



K/S graph of sample-B

Figure 3: K/S graphs of sample A and B

IV. Conclusions

The jute-cotton blended fabric with different proportion of jute and cotton fiber for sample A (50:50) and sample B (30:70) was characterized on weave design, yarn count, fabric density, cover factor, weight per unit area (g/m^2), fabric strength, dyeing performances such as wash and rubbing fastness, reflectance and color strength. The study reveals that, the characteristics of blended yarn fabric can be used as fully cotton fabric which may reduce the dependability on importable cotton fiber. On the whole, it may be said that, not only depending on the cotton fiber, but also jute-cotton blending may reduce the dependability on 100% cotton yarn. The use of fabrics made from Jute-Cotton blended yarns would surely strengthen our economy by cutting a part of the cost incurred for importing cotton and enhancing the value addition due to locally produced cheaper jute as a raw material, an opportunity to integrate the blended yarn into the production of jute-cotton denim and other heavy fabrics also.

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