Bangladesh J. Sci. Ind. Res. **42**(3), 281-286, 2007

A Study on Sulphonated Jute-cotton Blended Yarn and Fabrics and their Characteristics

M. A. Salam, F. I. Farouqui and Md. I. H. Mondal

Department of Applied Chemistry and Chemical Technology, Rajshahi University Rajshahi 6205, Bangladesh

Abstract

Sulphonated jute fibres were blended with cotton at three different ratios, e g. 50:50, 60:40 and 70:30 for production of fine yarn and comparatively better ratio have been investigated. The plain woven fabric were prepared by sulphonated jute-cotton yarn. The set of warp and weft blended yarns was done on the one up and one down principle. The physico-mechanical properties of blended yarn and fabrics were studied and compared with that of jute yarn, cotton yarn and fabric.

Key words : Sulphonated jute fibre, jute-cotton blend, mechanical properties, tensile strength and fabric construction.

Introduction

Natural jute as a textile fibre suffers from inherent defects which limit its spinning to yarn for producing packing clothes. Some investigators (Procter *et al.* 1967; Yorston 1942; Berzins 1966) have been reported that sulphonation improves the physico-mechanical properties of jute fibre.

Blending of fibres is usually made with different fibres having dissimilarity in their properties, with a view to achieving or improving certain characters of the yarn or its processing performances. Fabric produced from the blended yarn might have better characteristics than what could be obtained in a fabric produced from a single fibre. 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 blended this fibre with cotton would be a break through in the field of textile. The most important property of a textile fibre is the spinning property. Due to the inherent defects of jute, its spinning properties are not good. With the very expectation of success in fine spinning it would be interesting to develop fibre spinning technology for versatile testile use of jute fibre. Again, the spinning of more fine yarns from jute-cotton blends has not been possible without sulphonation of jute fibre. In view of the above fact in the present section, the spinning performances of the sulphonated jute fibre in combination with cotton is investigated.

Materials and Methods

Sulphonated jute fibre, cotton (collected from local market), sizing agent (starch, wax and china clay).

Sulphonation of jute fibre

Jute fibres were sulphonated with sodium sulphite in presence of ethylene diamine (EDA) (Janson *et al.* 1966).

Sulphonated jute fibre blended with cotton

The sulphonated jute staples were blended with cotton in the ratio of 50:50, 60:40 and 70:30. The fibres of the jute staples were individualised by passing through the opener machine and were then mixed up with cotton samples in the required proportions. These were then processed in the mini carding machine. Several passages through the carding machine were made for intimate blending of the component fibres. The card slivers were then fed to the mini drawing machine and were spun to 30 tex yarns.

Measurement of count

210 yds of yarn in length winded on the laboratory reeling frame were weighed and an average of ten such readings were taken to measure the count of the yarn. The yarn counts measured in both jute systems, i.e. number of pounds in 14,400 yds and cotton systems, i.e. number of hanks (840 yds) in a pound were expressed in the international unit of “Tex” which measures number of grams in one kilo meter length of the yarn. The count in tex was taken as a measure of linear density of the yarn.

The count strength product (CSP)

The concept of CSP may be used to derive an index by which the spinning quality of a fibre may be assessed or, the spinning efficiency of a particular system. It was obtained as the product of cotton count and lea strength of the yarn. A hank of yarn, with its starting and finishing ends knotted, was placed over the hooks of the lea tester, pendulum lever type, made by Good Brand & Co. Ltd. As the lower hook descend a load was imposed on the loops of the yarns constituting the hank. The maximum load to break all the threads unraveling the hang was indicated on the dial, which was “lea strength” of the hank.

Preparation of fabrics

Samples of fabrics of the length 10 metres and width 1metre were made by hand loom at Dogachi, Biral, Dinajpur. The weaving was performed with the blended yarns made of the sulphonated jute fibre with cotton. The set of warp and weft yarns was done on the one up and one down principle followed for the weaving plain or square cloth.

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 (Sobue 1956).

$$Kc = K_1 + K_2 - K_1K_2/28$$

Where, Kc = 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

$$K = \frac{\text{Thread per inch}}{\sqrt{\text{Count}}} = \frac{n}{\sqrt{N}}$$

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

Measurement of breaking strength

The breaking strength of the fabric samples were measured on a Tensile Strength Tester with a clam speed of 30 mm/min and specimen length of 5 cm. Two specimens per sample of fabric were prepared for the test. In the experiment the Zwick Fabric Tensile Strength Tester was used (Stout *et al.* 1955).

Measurement of Drape co-efficient

The draping properties of the fabric specimen under test were measured following the procedure of the Fabric Research Laboratories, USA (Elliot *et al.* 1960). The drape was measured as the drape co-efficient F which is the ratio of the projected area of the draped specimen to its undraped area, after deduction of the area of the supporting disk.

Thus

$$F = \frac{As - Ad}{AD - Ad}$$

Where,

A_D = The area of the specimen

Ad = The area of the supporting disk, and

As = The actual projected area of the specimen.

Measurement of flexural rigidity

The flexural rigidity which is a measure of stiffness associated with handle of cloth was determined from the following relationship (Kaswell 1953).

$$G = WC^3 \times 10^3 \text{ mg/cm} = \text{mN mm}$$

Where,

C = Bending length

W = Cloth weight (g) per square cm

N = Newton

Results and Discussion

It is seen from the Table 1 that 50/50 blends of sulphonated jute and cotton give yarn having its physical properties nearly close to 100 % cotton indicating better compatibility of the mixed component fibres. The tenacity of the blended yarn containing 60 % sulphonated jute fibres decreased to 10.0 being about 9.6 % reduction and its CSP decreased to 1590 being about 6.02 % reduction. It did not indicate deterioration of the weaving characteristics of the yarns, because the yarn quality expressed as lea CSP is expected to be 1250-1300 for power loom

warp. Moreover, the increase of yarn rigidity is not very much significant on being the sulphonated jute fibre mixed up with cotton even upto 70% in comparison with rigidity that develops with jute fibre mixed up at all percentage with cotton.

It is also seen from the Table I that the flexural rigidity of sulphonated jute yarn is 11.94 mN mm, i.e. 60 % higher and CSP is 1027, i.e. 45 % lower than that of 100 % cotton yarn. These results indicate that the production of fine yarn and fabric is not possible from 100 % sulphonated jute fibre because the yarn quality expressed as lea CSP is expected to be 1250-1300 for power loom warp. It is also observed from the Table I that comparatively (from economic point of the view) better sulphonated jute-cotton blended fibre is produced when sulphonated jute fibre is blended with 40 % cotton.

Table I. Physical properties of sulphonated jute-cotton blended yarns

Yarn sample, (30 tex yarn)	Breaking strength. (g/tex)	Elongation at break. (%)	CSP	Flexural rigidity. (mN mm)
50/50 Jute/cotton	10.93	5.80	1630	7.50
60/40 Jute/cotton	10.00	5.62	1590	8.20
70/30 Jute/cotton	9.10	4.85	1480	10.00
Cotton (100 %)	11.50	6.40	1692	4.72
Sulphonated jute (100 %)	10.60	5.71	1027	11.94

Production of fabrics with sulphonated jute-cotton blended yarn

The fabric construction

The plain weave fabrics made from the sulphonated jute-cotton blended yarn have shown a very good prospect of performances as they are comparable to the structure of cotton fabrics.

Fabrics from the blended sulphonated jute-cotton yarn

The details of the fabric samples prepared from the sulphonated jute-cotton blended yarns have been shown in the Table II.

The plain weave structure was chosen for fabric construction from the sulphonated jute-cotton blended fibre, because maximum fabric about 70% are of plain structural pattern. From the Table 2, it is seen that each

Table II. Fabric construction from sulphonated jute-cotton blended yarns fabric

Fabric sample	Yarn composition (Blended ratio)	Yarn count (tex)	Thread per (cm)	Cover factor	Cloth cover	Weight, (g/m^2)
A	Sulphonated jute / cotton 60/40	Warp 30 Weft 30	Ends 16 Pick 15.5	Warp 9 Weft 9	15.30	136
B	Cotton 100 %	Warp 30 Weft 30	Ends 21 Pick 21	Warp 9.4 Weft 9.4	14.00	110

kind of fabric is woven with equal set of warp and weft 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 tex, but the cover factors for both warp and weft and their resulting effect on the fabric is maintained almost identical. The fabric samples prepared from sulphonated jute-cotton blended yarn had cover factor of warp and weft 9.4 and cloth cover 14.00, respectively. The weights per unit area were, however, different for different cloths in accordance with the quality of yarns used. The geometrical properties of the fabrics from blended sulphonated jute fibre were favorably compared with 30 tex cotton yarn fabric.

Mechanical properties

The mechanical properties of the fabric samples woven with the sulphonated jute-cotton blending yarn have been shown in Table III.

The light weight fabric was made with blended yarns preferably with 30 tex yarn taking from a lot of 60/40 blended as shown in the Table III. The mechanical properties of the fabric was determined to observe their serviceability in the practical usages and to as certain their suitability as jute blended cotton fabric. Shirting and suitings are usually made from cotton yarn or the blended yarns thereof. The use of jute fibre after having sulphonated in the field of making such fabric has been a good possibility. The results shown in Table III indicate that the softness and handling characteristics represented by the bending length and flexural rigidity of the blended fabrics are very much comparable to those of cotton fabric with identical fabric structure. The bending length and flexural rigidity of the fabric samples prepared from sulphonated jute-cotton blended yarn were 1.82 cm and 8.25 mN mm, respectively and which are only 0.3 and 4.75 points higher than those of cotton fabric.

It is evident from the Table III that the tensile strength of the blended fabric is 20.0 kg which is very near to 23.1 kg strength of cotton fabric. It signifies that the durability and serviceability of the blended fabrics under any sort of stress and deformation during

Table III. Mechanical properties of fabrics prepared from sulphonated jute-cotton blended yarn

Sample no.	Fabric composition	Bending length (cm)	Flexural rigidity (mN mm)	Breaking strength (kgf)	Drape coefficient, (%)
X	Sulphonated jute / cotton (60/40) blended 30 tex yarn	1.82	8.25	20.00	38.00
Y	Cotton (100%) 30 tex yarn	1.65	4.50	23.10	35.00

their use are not much less than the cotton fabrics.

The sulphonated jute-cotton blended fabrics draped very elegantly in almost the same way the cotton fabrics draped over a circular support. Table III shows that the drape co-efficient of the blended fabric is 38.0, which is 2.88 point higher than that of cotton fabric.

References

Berzins, V. (1966) Micro-kappa numbers. *Pulp Paper Mag. Can.* **67**(3) : T206-208.

Elliot, B.G. and Hamby, D.S. (1960) Hand Book of Textile Testing and Quality Control. p. 192.

Janson, J. and Sjostroms, E. (1966) Sulphur content in relation to the degree of sulphonation in birch and spruce sulphite pulp. *Svensk Papperstidning*. **69** : 107.

Kaswell, E.R. (1953) "Fabric Hand" Textile Fibre Yarns and Fabrics, Chap. 20, Reinhold, New York.

Procter, A.R. Yean, W. Q. and Gorin, D.A. (1967) *Pulp Paper Mag. Can.* **68** : T455.

Sobue, H. and Okubo, N. (1956) **39** : 415.

Stout, S.P. and Jenkins, J.A. (1955) *Ann. Sci.Text. Belg*. **31**(4) : 231.

Yorston, F.H. (1942) Studies in sulphite pulping, Dominion Forest Service Bull, 97, Ottawa.

Received : February 01, 2001;
Accepted : July 03, 2007