ISSN: 1999-1630

SEU Journal of Science and Engineering, Vol. 13, No. 1, June 2019

A review on Sustainable Textile Products from Jute and Cotton Blends

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Abstract
This review has emphasized the investigation on jute-cotton blended yarn and fabric. It was found that almost all the research works on jute-cotton blending were optimistic to produce sustainable textile products. This will surely reduce the dependability on cotton. Jute can be blended with cotton fibres to produce suitable yarn for manufacturing heavy fabrics that can be consumed for furnishing fabrics, heavy clothing materials like denim and heavy polo knitwear. Such use would surely strengthen our national economy by cutting a part of the cost incurred for importing cotton and by enhancing the value addition due to the use of locally produced jute.

Keywords*: Jute-cotton blend, sustainable products, cost effective.*

I. Introduction

Blending is a long practiced method and being diversified depending on expanding demand of local and global markets of apparel, home textiles and technical textiles. Jute-Cotton blend is one of the possible options to reduce the dependability on the cotton. Shilpa *et al.,* (2007) reported blending jute with cotton fiber is an acceptable way of jute diversification by which value added products can be produced. Hence, the techniques of softening and blending could upgrade the quality of jute and thus, form a new class of jute-based fabrics having an expanding market. Salam *et al.* (2007) identified the blending of cotton 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.

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. Pan *et al*. (1999) described jute as a ligno-cellulosic bast fiber, which possesses hard and harsh qualities also make it difficult to produce apparel and other fancy fabrics to use in our day to day life. It is obtained from the bark of the jute plant containing three main categories of chemical compounds namely cellulose (58~63%), hemi-cellulose (20~24%) and lignin (12~15%) where the units of cellulose are surrounded and cemented together by lignin and hemi-cellulose. Jute has several advantages like lustrous golden appearance, high tenacity, high moisture regain, bio-degradability and other good properties; also the fibre can cut into staples of suitable length for blending with other fibres.

For these reasons, jute could be blended with cotton. The product obtained after blending jute and cotton would be sustainable in Textile sector. A review on this topic has been done and research findings from 1976 to 2018 have been summarised in this paper.

II. Background

As the demand for natural comfort fibres increases, the demand for jute and other natural fibres that can be blended with cotton will also increases. The evolution of the blending process is a continuous story where the number of researches conducted so far would probably be surpassed by

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Azad *et al*. (2006) provides interesting information that claimed that jute-cotton blend of different ratios while spun in rotor system, the properties of 50:50 blended yarn were almost nearer to that spun from 100% cotton in terms of yarn imperfection (thin-thick places and hairiness). Authors also mentioned that coarse count yarn (namely 10^s) from the blend ratio 80:20 (cotton-jute) shows similar trend. But the data reported in their published article has shown the quality of the blended yarns deteriorated with the increase of the proportion of jute. However, in case of further higher count, the blend ratio 80:20 (cotton-jute) can give better quality as compared to 50:50 ratio.

In another report, Islam *et al.* (2006) observed that fabrics formed by various types of jute blended yarns (sulphonated jute with cotton, rayon, acrylic, polyester and silk waste) demonstrated significant improved drape properties and flexural rigidity, but with a slight decline of tensile strength than 100% cotton yarn. The dye-ability of these fabrics for basic and reactive dyes was found up to increase by 20%. 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 were investigated. The study shows that with the increase of proportion jute in the mixture increases tenacity & and CSP of the yarns. The research findings, however, agree with much known fact that the increase of jute proportion cut the breaking elongation of the corresponding yarn than 100% cotton yarn. But it is worthwhile noting that the sulphonated cotton-jute blended yarn can enhance the resultant breaking elongation a little than 100% suphonated jute yarn.

Shilpa *et al.* (2007) refers to different research outcomes claimed that jute & cotton (50:50) blended yarn is appropriate for knitting. Its appeal would be increased by dyeing with an environment friendly dye; the 'T' shirts proved to provide warmth. Therefore, it could be best suited as winter wear in the countries with tropical climate, while quite comfortable for the autumn & spring in winter prone countries. Debnath *et al.* (2007), refers the physical and mechanical behaviour of the jute and hollow polyester (80:20) blended single, 2-ply and 3-ply yarns. Alkali treatment, bleaching and dyeing were the chemical treatments given to develop 2-ply and 3-ply bulked yarns. The jute-hollow polyester blended yarn could show higher bulk over similar commercial yarns due to low yarn packing yarns but with a little inferior mechanical properties.

Xia *et al.* (2009) reported an interesting issue regarding jute and cotton blending that the tenacity of jute and cotton fibres is more sensitive to the gauge length than overall along the length of the blended yarns, because fragmentation takes place during the yarn extension at increased rate. As the jute content increases, the tenacity of jute-cotton blended yarns becomes more and more sensitive to the gauge length. Conducting Uster evenness test on jute-cotton blended yarns, they showed that the mass irregularity, thick and thin places of blended yarns increase as increases the percent of jute to the blended yarns.

Salam *et al.* 2010 compared some properties and use-suitability of blended curtain in respect to 100% cotton curtain of similar construction. The research concluded that as compared 100% cotton curtain the same made of jute-cotton blended (50:50) yarn was not only 33% cheaper but better too by serviceability, except the case of repeated washability.

III. Yarns from Jute and Cotton Blend

The recent publications indicate that jute can be blended with cotton. Many studies have been done on Jute/Cotton blending; Wang *et al.* (2010) studied the chemical modification of Jute fiber and observed that the degumming process on the removal of impurities was an effective method for jute fiber. Shilpa *et al.* (2007) studied the growing importance of cotton blends in apparel market. It also revealed the reasons for blending is to produce fabrics with a better combination of performance characteristics in the product. Chidambareswaran, *et al*. (1976) studied the x-ray diffraction of cotton/jute blends, for analyzing the blend compositions in yarns spun from blends of cotton and jute fibers. Azad and Jafrin (2009) studied the effect of size material on jute-cotton union fabric and showed the effect of sizing on the properties of jute-cotton union fabric. In the

investigation, the cotton yarn was sized and used in warp and jute yarn was used in weft direction. It was found that the strength of the sized union fabric was greater than that of unsized union fabric. But other properties of the fabric found similar in comparison to the properties of union fabric with 100% cotton fabric.

Azad *et al.* (2006) studied the physical properties of mattress cover produced by rotor spun blended yarn and 100% cotton yarn. In this work, it showed the properties of mattress cover which was produced by jute-cotton (80:20 and 70:30) blended yarn. The average warp wise strength and abrasion resistance of 80:20 blended fabric samples were comparable and very closer to that of the cotton fabric. Prathibadevi *et al.* (2013) studied the effect of jute proportion on the color strength value of jute/cotton union fabric, The experiment was focused on the effect of jute content on the colour strength and fastness properties of finished fabric. The result revealed that the colour strength value (K/S) was higher in the case of fabric proportion with more jute (70:30 jute/cotton). Parthasarathy *et al*. 1981 studied cotton-jute blending-changes in blend composition during processing.

Haque *et al*. (2013) studied the spinning combination with cotton and jute/wood cell using ring frame. In this work it has been developed a process of cotton wood cell/jute cell blending. Mahabubuzzaman *et al.* (2007) studied the quality of blended jute yarn through two different process lines. In this work two techniques applied to produce quality jute/cotton blended yarn in slip draft spinning machine. One process was through Hopper feeder and Teaser card blending with jute fiber cutting as staple form and another process was through breaker card feed lattice blending with long jute fibre. Among the processes, the produced yarn blending with long jute through breaker card feed lattice was found better.

Kalyanaraman and Ramakrishnan (1995) studied the measurement of blend Proportion in Jute–Cotton Yarn with the assistance of a High Volume Tester, This work highlights an easy way to estimate the blend proportion by using the well-known high volume fiber fineness tester. A range of publications have revealed that jute has the ability to be blended with other fibres, both synthetic and natural, and accepts cellulose dye classes such as natural, basic, vat, sulfur, reactive, and pigment. Foisal *et al.* (2014) studied the dyeing of cotton-jute blended yarn with reactive, direct, vat and sulphur dyes to find out the affinity of different types of dyes on the cotton-jute blended yarn. It was observed that almost all the dyes have the affinity to cotton-jute blended yarn with moderate fastness properties. Ullah A. ANM (2012) studied the ring and rotor spinning of jute cotton blended yarn (40 Tex). It was found that with the increment of jute fiber percentages in blend ratio tenacity decreases while breaking elongation, unevenness, thick, thin and neps increases. An interesting finding of the test results is that, with the change of atmospheric condition the results are also varied. Table 1 shows the results of the properties of the blended yarn.

Table 1: The properties of 40 Tex Jute-Cotton yarns in different spinning techniques

Spinnig Technique	Blend Ratio Jute : Cotton	Tenacity (cN/Tex)	Breaking Elongation (%)	Unevenness (U%)	Thick/km (+50%)	Thin/km (-50%)	Neps/km (+200%)
Ring	20:80	9.60	6.55	14.35	224	114	410
	35:65	8.95	6.82	15.00	300	196	460
	50:50	8.93	6.83	17.25	1003	380	1305
Rotor	20:80	9.40	6.62	14.20	194	70	315
	35:65	8.87	6.84	14.60	235	115	380
	50:50	8.56	7.00	15.90	880	411	500

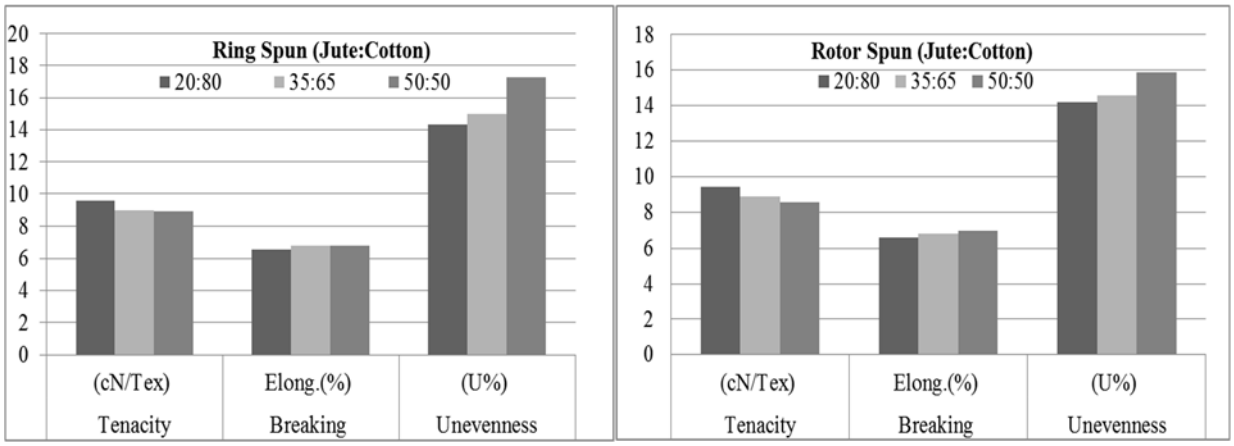

Figure 1: Comparison on the properties of 40 Tex Jute-cotton blended yarn Ring spun (left) and Rotor spun (right) showing the increment of jute percentages.

Figure 1 shows the comparison on Tenacity (cN/Tex), Breaking elongation (%) and Unevenness (U%) of 40 Tex ring spun(left) and rotor spun(right) yarn which indicate that with the increment of jute percentages tenacity decreases, elongation and unevenness increases. It is assumed that 20: 80 jute-cotton blended yarn is better as compared to 35:65 and 50:50 blends

IV. Fabrics from Jute and Cotton Blend

Ullah A. ANM *et al.* (2016) reported the characteristics of jute/cotton blended fabrics with different ratio (50:50), (30:70) on yarn count, weave design, fabric density, cover factor, weight per unit area (g/m^2), fabric strength, dyeing performances e.g. wash, rubbing fastness, reflectance and color strength. Ullah A. ANM *et al.* (2018) also reported the properties of jute/cotton blended fabric after washing with enzyme, stone and acid. It was revealed that the changes in GSM, shrinkages, tensile strength, abrasion, pilling, wash and rubbing fastness of blended denim fabric were not remarkable and can be comparable with 100% cotton denim fabric. Vigneswaran and Chandrasekaran (2009) reported the effect of thermal conductivity behavior of jute/cotton blended knitted fabrics. The experimental result showed the lower thermal conductivity at higher jute blend proportions. It also exposed that fabric air permeability and tightness factor values influences the thermal conductivity of jute/cotton blended knitted fabrics. The thermal insulation values were higher with higher fabric tightness factor and lower air permeability. Salam (2005) studied the color fastness properties on bleached sulphonated jute-cotton blended fabrics with basic dyes. The light and wash fastnesses of the dyed sulphonated jute-cotton blended fabric samples were much better.

V. Conclusion

This study has showed that jute-cotton blended yarn with an efficient blend ratio can be a lucrative potentiality that can be utilised by our textile industry to produce heavy textile fabrics because of the cheap abundance of jute fibers and more costly and non-available cotton fibers in our country, cotton-jute blending in the modified form and finally, the fabrics made from the blended yarns may be used as Denim/Jeans products and also in making curtains, bed covers, furnishing fabrics etc. It can be said that not only depending on the cotton fiber but also jute-cotton blending may reduce the dependability on 100% cotton yarn and will share the large amount of foreign currency for importing raw cotton used in making fabrics for textile and garments sector.

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