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Evaluation of Moisture Transfer properties of P/ V/ Jute Fabrics

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Abstract

The focus of the paper is to evaluate the moisture transfer properties of polyester/ viscose/ jute blended fabric and compare with polyester/ viscose fabric of similar construction. Jute sliver was cut to staple length of 51 mm so that it may be blended with polyester and viscose. Two types of yarns were prepared with a blend of 65/ 35 polyester/ viscose and 65/10/25 polyester/ viscose/ jute. From these yarns two fabric samples were prepared, each fabric having epi/ ppi 56/48. Moisture transfer properties of polyester/ viscose/ jute fabric was evaluated and compared with polyester/ viscose fabric having similar construction. Wicking test was performed to observe increase in height of water level in the fabric. Spot test was performed to observe time taken for disappearance of water drop over the fabric surface. Water evaporation through the fabric was also observed for polyester/ viscose and polyester/ viscose/ jute fabric. It has been found that moisture transport is faster in polyester/ viscose fabric than polyester/ viscose/ jute blended fabric. Wickablity is greater in case of P/V fabric. Due to high rate of wicking in case of man-made fibers, drop absorption time is less in P/V fabric. Moisture evaporation in case of polyester/ viscose /jute fabric was found slightly greater than polyester/ viscose fabric.

Keywords: Jute Blended Fabric, Moisture Transport Properties,Wickability, Jute blending.

Introduction

Jute is a natural cellulosic fibre. Jute is annually renewable and commercially available bast fibre. Jute has been used as a packaging material over a long period of time. It is very commonly used for packaging food items like wheat, sugar, rice etc. Jute fibre has relatively high modulus and strength. It is easily available inexpensive natural fibre. Jute fibre has not been tried for apparel fabrics because jute alone can't provide properties required for apparel fabrics.

For apparel fabrics, it is necessary to blend dissimilar fibres because one fibre is not able to impart desired properties of the fabrics. In case of suiting fabric, if the fabric is made from polyester only, this kind of fabric would be having good tensile, tearing strength, excellent dimensional stability, crease retention, crease recovery, quick drying and excellent abrasion resistance. However fabric made from polyester fibre only will have some undesirable properties such as static charge development, hole melting, pilling and hydrophobic nature and poor hand. If the fabrics are made from 100 % viscose then fabric will be having low tear strength, tensile strength, poor crease resistance and crease recovery, and lower abrasion resistance. If we blend polyester and viscose then positive attributes of both fibres may be utilized. The resultant fabric will be having reduced static propensity, good moisture regain values and wear comfort, good tensile and tear strength. Addition of viscose fibre will also improve affinity of dyes and chemicals used in finishing of fabrics. Hence suiting fabrics are most commonly made from blends of polyester and viscose.

Although jute is conventionally used as a packaging material and carpet backing yet it can also be used as a blend partner for suiting fabrics. An acceptable way of jute diversification is blending jute with polyester, viscose fibres for producing suiting fabrics. This kind of fabric is expected to perform well as suiting fabric because it will have positive attributes of polyester like good tensile, tear strength, abrasion resistance, durability as well as positive attributes of jute, viscose like moisture regain, lesser static problem.

Review of Literature

Earlier studies on jute can be divided into many sections like packaging material, properties of woven jute fabrics, chemical treatment of jute fabrics, geo- textiles. Jabbar A. et al[1] have studied static and dynamic mechanical properties of novel treated jute/ green epoxy composites. The focus of this paper is to evaluate the mechanical and dynamic mechanical properties of woven-jute fabric re-inforced green epoxy composites as a function of modification of jute fibres by enzyme. The degree of inter-facial adhesion between the jute fibre and green epoxy was anticipated using the adhesion factor obtained through dynamic mechanical analysis data. Complex modulus variations and phase behavior of composites was studied. Paul Palash et al. [2] have studied relationship among seam strength, weft-way fabric strength and stitch density of B. Twill jute bag. The influence of weft-way fabric strength and stitch density, on the seam strength of B. Twill jute bag has been studied. Study reveals that a correlation exists among seam-strength, weft way fabric strength and stitch density of B. Twill jute bags sewn with herakle stitches. A regression equation for seam strength as a function of two factors namely weft way fabric strength and stitch density has been established. Few references are available on blending of jute with manmade fibres like polypropylene, acrylic and polyester. Sengupta S. has blended jute fibre for ternary blends [3]. Two types of jute based blended yarns have been developed from jute-shrinkable acrylic-hollow polyester in 50:30:20 ratio and jute-polypropylene-holllow polyester in 50:25:25 ratios. Yarn properties and dimensional stability of the fabrics have been evaluated. Blending of jute with viscose fibre has also been tried. Debnath C.R. [4] has tried jute- viscose blending and tried to find some optimum conditions. Viscose staple fibre was blended with Tossa jute. For blended yarns the optimum twist factor was practically found. Weaving efficiency and fabric quality showed improvements even with 10% viscose in the blend. The use of bleached jute in the blend increased whiteness at the loss of strength.

Some researchers have also tried jute blended yarns on rotor and friction spinning system. Sett S.K. et al[5] have studied tensile characteristics of rotor and friction spun jute blended yarns and also some understanding of their structure- property relationships. Jute blended yarns were produced on two spinning systems, open-end and friction (Dref-2). It was concluded that tensile and visco-elastic behavior of rotor and friction (Dref-2) spun jute blended yarns depend partly on fibre alignment and partly on non-compatibility of the tensile properties of component fibres. References are also available regarding testing of jute fibres. Mukhopadhyay[6] have studied jute fibres under scanning electron microscope. The surface features of jute fibres after mild alkali and acid treatments were studied using scanning electron microscope to reveal the fibrillar arrangement in different layers of fibre. Few helical fibrils were noted in the study. Roy Gautam[7] has developed electronic fineness tester for jute and allied fibres with the aim to replace manual air- flow fineness metre in order to eliminate the possible human error. This instrument provides automatic result in tex for the fibres under test. Sengupta S.[8] has measured electrical resistance of jute canvas, hessian and cross-laid needle punched non- woven fabrics in a laboratory made set up.

Comfort is one of the most important aspects of clothing. Clothing comfort can be divided into three groups: Psychological, Tactile and Thermal comfort[9]. Moisture transport through clothing plays a key role on comfort. Wicking behavior and water vapour transfer tests are necessary to be performed for measurement of moisture transport properties[10].

Aim of the Study

The aim of the study is as follows

1. To prepare two yarn samples having same count, twist of polyester/ viscose and polyester/ viscose/ jute under identical conditions.
2. To prepare plain weave fabrics from polyester/ viscose and polyester/ viscose/ jute yarns with same ends per inch, picks per inch, weave, loom, weight.
3. To check the moisture transfer properties of polyester/ viscose and polyester/ viscose/ jute fabrics.
4. To suggest end-uses of fabric as per results of moisture transfer properties.

Material and methods

Polyester fibre of 1.5 denier, cut length 51 mm and Viscose fibre of 1.5 denier, cut length 51mm were used for the study. Length of jute fibre is variable. Hence to make it compatible for blending with polyester and viscose, it is necessary to cut jute fibre to equal length.

The process of obtaining jute fibre is as follows- Bundle of jute stem- Retting- Stripping- Drying- Opening- Spreader machine for softening and Lubrication- Carding- Gill Box. The jute sliver obtained from Gill Box was cut to staple length of 51mm with the help of cutter and then blended with polyester and viscose in desired proportion by stack blending method.

Two types of yarn samples were prepared. One is Polyester/ Viscose 24^s yarn having blend ratio 65/35 P/V and Polyester/ Viscose/ Jute 24^s yarn having blend ratio 65/10/25 P/V/J. During blending antistatic agent LV 40 and P- 2152 were also added in the normal proportion (0.5 % each) so as to avoid static problem in the spinning section. The sequence of machines was same for both samples. Blow room, Carding, Drawframe (two passages), Simplex, Ring Frame, Winding machine, Cheese winding and Two For One twister. During spinning twist per inch was set 14.2 for both yarns. Precautions were taken to

avoid loss of jute fibre at each stage of spinning. Grid bars were closed in blowroom. Speeds were kept lesser at each stage of spinning so as to avoid loss of jute fibre.

Two types of yarns were prepared $2/24^{s}$, 65/35 P/V and $2/24^{s}$, 65/10/25 P/V/J. From these two types of yarns, two types of fabrics were prepared. One fabric sample from $2/24^{s}$, 65/35 P/V yarn in the warp and weft same. Second fabric sample was prepared from $2/24^{s}$, 65/10/25 P/V/J in warp and weft both. Two plain weave fabrics were prepared. These two fabrics were processed in the following way- Singeing, Scouring, Silicone finish and Mechanical finish was applied on the fabrics.

The fabric samples were prepared in such a way ends per inch and picks per inch were 56 and 48 respectively in both the samples. After processing the width of fabric was 57 inches for both fabrics. The weight of the fabric was kept 200 grams per square metre.

Properties of fibres and yarns used in the study are shown in the Table1.

Table 1 - Properties of fibres and yarns.

No.	Property	Sample no.1 Polyester/ Viscose 65/ 35	Sample no.2 Polyester/ Viscose/ Jute 65/ 10/ 25
	Fibre Specifications		
1	Fiber fineness	1.5 denier Polyester 1.5 denier Viscose	1.5 denier Polyester 1.5 denier Viscose 20 denier Jute
2	Fiber length	51mm Polyester 51 mm Viscose	51mm Polyester 51 mm Viscose 51 mm length after cutting Jute sliver
	Yarn specifications		
1.	Single yarn count	24^{s}	24^{s}
2.	Single yarn twist per inch	14.2	14.2
3.	Single yarn Twist Multiplier	2.9	2.9
4.	Double yarn count	$2/24^{s}$	$2/24^{s}$
5.	Double yarn Twist per inch	14.0	14.0
6.	Double yarn Twist Multiplier	4.0	4.0

The details of fabric preparation are shown in Table 2.

Table 2 - Details of fabric preparation

No.	Property	Sample no.1 Polyester/ Viscose	Sample no.2 Polyester/ Viscose/ Jute
	Fabric specifications		
1.	Warp count	$2/24^{s}$	$2/24^{s}$
2.	Weft count	$2/24^{s}$	$2/24^{s}$
3.	Weave	Plain	Plain
4.	Sett (Ends per inch×Picks per inch)	56 × 48	56 × 48
5.	Loom	Rapier	Rapier
6.	Weight (Gram per square metre)	200 GSM	200 GSM
7.	Finish	Silicon	Silicon
8.	Width	57 inch	57 inch

Fabric moisture transfer properties

After processing the fabric samples, both the fabrics were dry relaxed in the standard atmospheric condition at 65% RH ± 2% and 27^{o}C temperature and their moisture transfer properties were examined .

Spontaneous uptake of liquid in the plane of fabric is called wicking. The rate at which the water climbs up a narrow strip of fabric, suspended vertically with its lower end dipping into water. Two methods are used, strip test and spot test. For strip test, a strip of the test fabric 6 inches and 1 inch preconditioned, was suspended vertically with it's lower end immersed in distilled water as shown in Fig. 1.

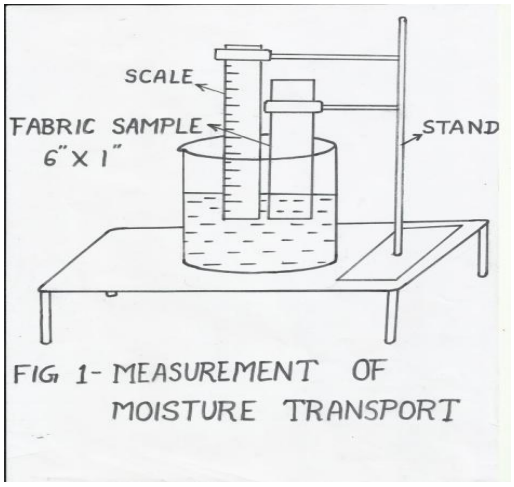

FIG 1- MEASUREMENT OF MOISTURE TRANSPORT

The height reached after constant time of 30 seconds, 5 minute and 15 minutes by water in the fabric above the water level in the reservoir was measured. Wickability of the test fabrics was measured from the wicking height by using formula:

Wickability = Avg rise in height × % of mass

% of mass = (Wet weight – Dry weight) ×100/ Dry wt

In case of spot test, a drop of liquid (distilled water, drop volume 30 mm^3) was delivered from a height of 6 mm onto horizontal specimen of test fabric. The region of test fabric was illuminated by a beam of light to create a bright reflection from surface of fabric. The time elapsed between the drop reaching the fabric surface and disappearance of the reflection from the liquid surface was measured. The time taken for complete absorption of the drop was noted.

For measuring water vapour transfer through the fabric, the single layer of fabric was sealed over a cylindrical cup, containing the water 1 cm below the brim. Evaporation takes place under standard atmospheric conditions. Loss in the weight of the cup was measured after 24 hours of starting the experiment.

Result & Discussion

Moisture transfer properties of polyester/ viscose and polyester/ viscose/ jute fabrics are shown in Table 3. From the Table 3, it is clear that moisture transport of polyester/ viscose fabric is greater than polyester/ viscose/ jute fabric in first 30 seconds. The same trend is observed after five and fifteen minutes. Moisture transport is faster in polyester/ viscose fabric. These results indicate good moisture transfer ability of polyester/ viscose fabric whereas poor moisture transfer ability of polyester/ viscose/ jute blended fabric is observed. Wickability of polyester/ viscose fabric is also greater than polyester/ viscose/ jute fabric

Results of spot test reveals that drop of water disappears quickly in polyester/ viscose fabric than in polyester/ viscose/ jute fabric. This can be explained by following discussion. During perspiration moisture transport is an important phenomenon. Smoothness of the fibre also plays an important role and helps in transport of moisture. Coarse denier and rough surface of the jute surface prevents fast transport of moisture and hence wicking rate is slow in polyester/ viscose/ jute fabric. Due to smooth surface of man-made fibers, the moisture transports more quickly. In case of P/V blended fabric both fibers are man-made, hence due to smooth surface, wickablity is greater in case of P/V fabric. In case of spot test, multidirectional wicking takes place. It takes more time in P/V/Jute fabric to disappear a drop of water due to slow rate of wicking. Due to high rate of wicking in case of man-made fibers like polyester and viscose, drop absorption time is less in P/V fabric.

Table 3 – Moisture transfer properties of polyester/ viscose and polyester/ viscose/ jute fabrics

Name of test		Polyester/Viscose	Polyester/ Viscose/ Jute
Wicking test	Height in 30 sec	0.3cm	Nil
	Height in 5 min	2 cm	0.2cm
	Height in 15 min	6 cm	1cm
	Wickability	24.48	15.38
Spot test	Drop absorption time (sec)	80 sec	620 sec
Evaporation cup method	Water vapor transfer (gm)	12.59	12.87

It is observed from Table 3 that weight loss in case of water through polyester/ viscose/ jute fabric is slightly higher as compared to polyester/ viscose fabric. Moisture evaporation in case of polyester/ viscose /jute fabric is slightly greater than polyester/ viscose fabric.

Conclusion

After comparison of Polyester/ Viscose and Polyester/ Viscose/ Jute fabrics, it was found that

1. Rate of wicking is slow in case of polyester/ viscose/ jute fabric. Hence polyester / viscose fabrics are supposed to transfer moisture and perspiration more quickly.
2. Time taken by a drop of water to disappear is much higher for polyester/ viscose/ jute fabric. It implies polyester/ viscose/ jute fabric will take more time to transport moisture or perspiration.
3. Water vapour transfer through single layer of fabric is slightly higher in case of polyester/ viscose/ jute fabric.
4. Polyester/ viscose/ jute fabric are suitable for outerwear fabrics because of slow wicking property, higher drop absorption time

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