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Influence of Bamboo and Cotton Blend Ratio on Low-Stress Tensile Properties of Garments

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***Abstract*—The Bamboo: Bamboo and Cotton: Cotton blends have widely attracted the low-stress tensile properties of textiles, especially for garment wear. The tensile properties of the garments showed that properties such as the linearity of tensile (LT), tensile energy (WT), tensile resilience (RT) and tensile strain (EM) of Bamboo-Cotton garments are influenced by increasing or decreasing the portion of Bamboo fibers. Moreover, the content of Bamboo fiber showed the direct influence on low-stress tensile properties of garments. The low-stress tensile properties are influenced by the portion of the Bamboo fiber, yarn diameter, and twist. Thus, the low tensile properties have given remarkable features for tailoring and suiting of clothes.**

***Keywords*- Tensile, Bamboo, Cotton, blend ratio, garments**

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I. INTRODUCTION

The fastest-growing grass fiber is known as Bamboo fiber, which ensures that there is no requirement of replantation after harvesting.

Moreover, the plant of Bamboo does not need any fly spray or fertilizers for agriculture and thus, decreases the environmental pollution. The textile fiber researchers have utilized Bamboo as a raw material to manufacture rayon fibers, consuming the chemical route followed for the production of viscose fiber. The yarns spun from Bamboo fibers are more delicate in diameter, less hairy, more flexible, and better stretchable compared to Cotton yarns [1]. Furthermore, Bamboo fibers are well-known to have superior antimicrobial and UV light protection properties, although some researchers have raised questions on the industrial application of Bamboo fibers [2-4].

In comparison to the Cotton, the fabrics made from Bamboo viscose yarns showed higher moisture vapor transmission and lower thermal resistance [5, 6]. It was also studied that Bamboo textiles ensure a very soft feel. Therefore, Bamboo fabrics are widely used for undergarments, socks, and sports clothing. Thus, it will be very novel to analysis the handling behavior of Bamboo, which can be governed by the low-stress tensile properties, of Bamboo and Bamboo, blended woven fabrics [7]. A fabric handle is reliant on compound communications among tensile, bending, shear, and compressive deformation at low stress. Fabric handle characteristics are evaluated subjectively by sliding the fabric between finger and thumb, which gives some feel through which we can judge about stiffness, softness, smoothness, bulkiness, and crispiness of the structure.

In the last decades, researchers generated tremendous interest in the low-stress tensile properties of woven garments [8, 9]. They used plain woven fabrics to modulate the garment's tensile behavior by linking yarn and fabric geometries and the role of yarn parameters on the tensile property of woven clothes. According to a study, the tensile, bending rigidity, bending hysteresis, shear rigidity, shear hysteresis, and compressibility were found lower for Bamboo fabrics as paralleled to those of 100 % Cotton fabrics. Besides, extensibility, tensile energy, and compressional resilience were observed higher for 100 % Bamboo fabrics than 100 % Cotton fabrics. Another study suggested that higher pick density increased the linearity of the load-elongation curve, bending rigidity, shear rigidity, and tensile resilience [10].

There are limited studies that have been carried to evaluate low-stress tensile properties of garments against blend ratios of Cotton: Bamboo fibers at constant spinning and weaving parameters [11-15].

This study presents an evaluation of low-stress tensile properties (linearity of tensile, tensile energy, tensile resilience, and tensile strain) against blend ratio of Cotton: Bamboo fabrics and prediction of garment end-use.

II. MATERIALS AND METHOD

The ratio of Bamboo: Cotton is given in Table 1 with a sampling of blend ratio of Bamboo and Cotton. The plain-woven garments were examined and labeled as given in Table 2. The basic parameters of garments were 285 g/m^2, warp and weft count 60 Tex, ends/inch 224 and picks/inch 112, respectively. The manufacturing parameters of fabrics were kept precisely the same during the production of samples for garments. The mobility of cross threads influences the tensile properties of the woven fabric at the interlacement point. The samples are fed here in the measurement area then press button to start and wait

for the blinking of red light to the shown signal of operation start one measurement is finished the measurement table is moved to adjust another position of samples automatically. The fabrics were measured on the KES-FB1, and the measurements method is given in Table 1.

TABLE 1.Ratio of Cotton: Bamboo

S.No	Type	Ratio in %
F1	Bamboo: Cotton	66:34
F2	Bamboo: Cotton	70:30
F3	Bamboo: Cotton	73:27
F4	Bamboo: Cotton	76:24
F5	Bamboo: Cotton	80:20
F6	Bamboo: Cotton	84:16
F7	Bamboo	100

*F is for fabrics/garments

TABLE 2. Method of measurement of tensile properties

Low stress tensile properties	Maximum tensile strain	100 %
	Maximum shear strain 8 degree	7 mm
	Tensile strain rate	0.2 mm/second
	Clamp interval	20mm/10v
	Maximum load	50gf/cm
	Tensioning load	20 g

III. RESULTS AND DISCUSSION

Figure 1 presents the linearity of the tensile properties of Cotton: Bamboo blended garment. LT is determined as the linearity of tensile energy. The samples F2, F4, F5, F6 Bamboo-Cotton blends were shown more exceptional linearity of tensile property; this showed better handle the estate of woven garments and better comfort properties.

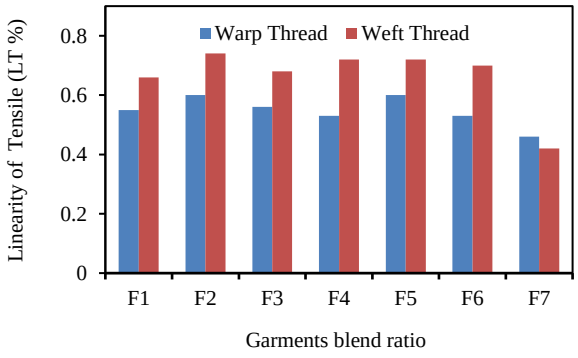

Figure 1. The linearity of tensile properties of Bamboo: Cotton blended garments

LT values of plain woven garments are considered higher than twill weaved garments. Lower the benefits of LT more top will be the extensibility of plain woven clothes. The warp thread is packed entirely in the garments, so that showed a lower linearity of tensile than the weft thread. The linearity of tensile is affected by twist, the structure of weave and linear density of yarn during manufacturing.

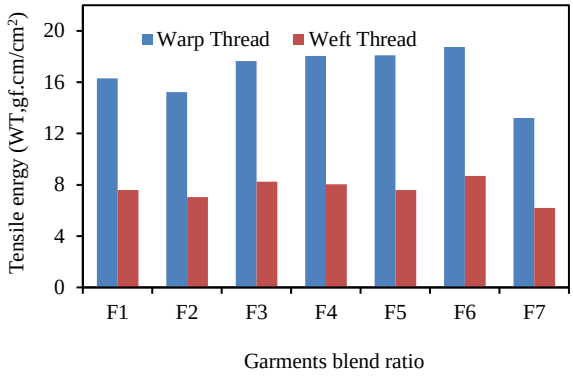

Figure 2. Tensile energy of Bamboo: Cotton blended garments

Figure 2 shows the tensile energy of Bamboo: Cotton blended garments. The WT tensile energy, which indicates the toughness of garments and WT also reflects the mobility of garments under deformation. If the fabric has high toughness values, it gives the lower handle of cloth. The results showed that the increasing portion of Bamboo fiber increases the value of the toughness of woven garments in both warp and weft direction. The WT values are seen smaller in the weft direction of the woven garments. It can be varied due to the process parameter of yarn manufacturing and fabric manufacturing.

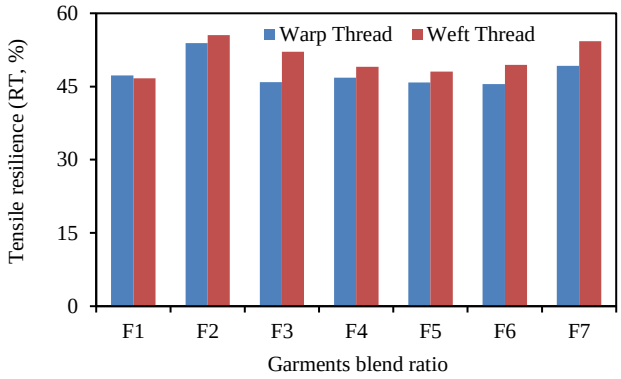

Figure 3. Tensile resilience of Bamboo: Cotton garments

Figure 3 illustrates the tensile resilience of Bamboo: Cotton blends. The tensile resilience (RT) is used to indicate recovery after the tensile deformation of plain-woven garments. The RT values of plain-woven fabric are almost considerable for both warp and weft in this work. It is shown that the garments have tighter construction, higher pick density, and functional recovery after crimp removal.

Figure 4 presents a low tensile strain of garments. Tensile strain (EM) is a crimp removal process during the tensile loading of woven clothes. It also influences on fabric tailor ability and

seam slippage. Higher the EM values give better comfort properties but entertain problem during stitching and steam pressing. EM values of F7 fabrics are higher than all other garments. It shows F7 fabric has excellent comfort properties, but it creates a tailoring problem in garment manufacturing. However, different all samples have given satisfactory results for comfort properties and touch properties; these fabrics can be used for tailoring in garments making and can also be used for curtains fabrics.

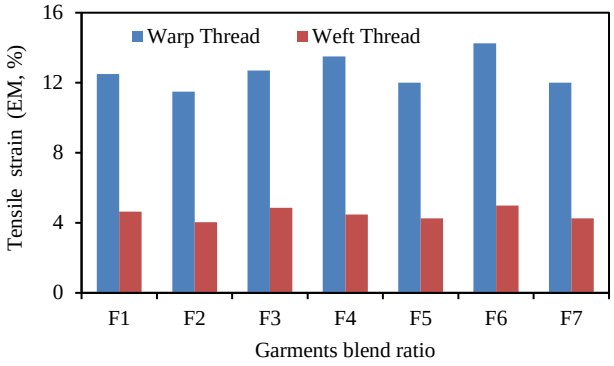

Figure 4. The tensile strain of Cotton: Bamboo blended garment

It reduces the movement of yarns in the structure of the fabric during the application of the tensile force. The garments made for this research work showed high pick density and more grams per square meter (GSM) in warp and weft direction. These parameters showed a direct influence on low-stress tensile property of garments. It is also recorded that the fabrics deserve the features for tailoring of the garments.

IV. CONCLUSIONS

This research work was done on the evaluation of low-stress tensile properties of plain-woven fabric and garments made from it. The low-stress tensile properties of garments were examined on the tensile and shear KES-FB1 tester, which belongs to the Kawabata measurement system for garments end-use property prediction. The garments are wearing properties of Bamboo: Cotton, 64:36, 80:20, 70:30, and blends shown good wear properties for winter suiting of garments. These garments have given remarkable features for tailoring and suiting.

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