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Research Article

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Functional Properties of Muga and Tencel union Fabrics

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ABSTRACT

Union fabrics are the fabrics where in the fibre content of warp is different from that of weft. Union fabrics are desirable because the properties of two sets of yarns are combined in a fabric for further use. In this study Muga silk was interwoven with Tencel yarn to incorporate the properties of Muga and Tencel yarn in a fabric. For the current study two control i.e. Muga and Tencel control, and three union fabric samples were woven. The union samples were Muga × Tencel 20s, Muga × Tencel 30s and Tencel 20s × Muga. The samples were woven using hand fly shuttle loom in plain weave. The fabrics were subjected to testing for functional properties such as cloth stiffness, cloth crease recovery, cloth drapability, cloth tensile strength and elongation, cloth abrasion resistance and cloth pilling. The bending length and cloth crease recovery degree of the union fabrics improved significantly compared to Muga control. As the bending length of the fabric samples decreases, drapability improved in union fabrics. Tencel 20s × Muga showed higher value of tensile strength in warp direction and Muga × Tencel 20s in weft way as well as cloth elongation in both warp and weft way was observed to be high in the latter sample.

Key words: *Muga, Tencel, Weaving, Union fabrics, Functional properties.*

INTRODUCTION

Silk industry in India has been identified as an employment oriented industry. India holds world monopoly in production of Muga silk along with tropical Tassar. The golden yellow colour silk is prerogative of India. Muga culture is specific to the state of Assam and an integral part of the tradition and culture of the state.

There has been a growing demand for absorbent fibres with the need hinging on comfort and fashion. Tencel is latest man-made cellulosic fibre, possesses many properties of other cellulosic fibres such as cotton, ramie and rayon. The lyocell fiber has a highly crystalline structure which offers good wet strength as well as excellent dry strength. Further, it shrinks less when wetted by water than other cellulosics such as cotton and viscose rayon[3]. Silk as a fibre, has good tensile strength, strongest natural fibre and has moderate abrasion resistance.

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Silk fabrics retain their shape and have moderate resistance to wrinkling. Silk has a liability and suppleness that, aided by its elasticity and resilience, gives it excellent drapability.

Thus, by taking into account the properties of Muga silk and the Tencel yarn, an effort is made to weave together Muga silk yarn with Tencel yarn with an objective to study the functional properties of the transformed fabric.

MATERIAL AND METHODS

Selection of sample

Muga silk yarn of 75 d was selected for the study which was procured from Sualkuchi in Kamrup district of Assam. The yarn was purchased in hank form. Tencel yarn of 20s and 30s were purchased in a cone from Pallava textile, Coimbatore, Tamil Nadu. The union fabrics were woven at a home weaving centre in Assam and Meghalaya.

Cloth stiffness

The test samples were tested as directed in BS test method: 3356-1961. The test sample were placed on the platform of cloth stiffness tester with the scale on top of it, length wise and the zero of scale coinciding with the leading edge of the test sample. Along with the scale slowly the sample was pushed and steadily when the leading edges project beyond the edges of the platform, the fabric was pushed slowly and the procedure was continued until the tip of the specimen viewed in the mirror cuts both index lines. The bending length was recorded from the scale mark opposite a zero line engraved on the side of the platform.

Cloth crease recovery angle

The specimens were tested as directed in IS method: 4681-1968 by using Shirley's crease recovery tester.

The specimen was creased for a definite period of time (5 mins) at a known load (2 kg) and mounted on crease recovery machine. The test specimens were allowed to recover or to regain its crease. The recovery was measured in terms of the extent of an angle to which the sample has been recovered. Readings were recorded for both warp and weft separately[2].

Cloth drapability

The specimen were tested as directed in IS test method 8357-1977. A specimen was cut by means of circular template and kept on supporting disc of the drape meter. On switching the lamp, it gave the shadow of draped area, which was taken on ammonia paper and is weighed. Similarly draped shadow area of the template and supporting disc was also taken. This drape coefficient was calculated by using the formula:

$$F = \frac{A_s - A_d}{A_D - A_d} \times 100$$

Where,

F- Drape co-efficient

A_s - Area of the shadow

A_d - Area of the shadow

A_D - Area of the template

Cloth tensile strength and elongation

The specimens were tested as directed in ASTM test method: 12616-1989. The method employed to determine the breaking load and elongation of the material was by using the 'raveled strip test' in UniStretch 250 tensile tester.

The specimen was gripped between two clamps of the tensile testing machine in such a manner that the same fabric was gripped by both the clamps and a continuous increasing load was applied longitudinally to the specimen by moving one of the clamps until the specimen ruptured. Values of breaking load of the test specimen were recorded from the indicator of the machine.

Cloth abrasion resistance

The specimens were abraded as directed under ASTM D-4970. Fabrics are mounted on the Martindale Tester, and the face of the test specimen is rubbed against the face of the same mounted fabric in the form of a geometric figure, that is, a straight line, which becomes a gradually widening ellipse, until it forms another straight line in the opposite direction and traces the same figure again under light pressure for a specific number of movements. The degree of fabric pilling or surface appearance change produced by this action is evaluated by comparison of the tested specimen with visual standards that may be actual fabrics, or photographs of fabrics, showing a range of pilling resistance. The observed resistance to pilling is reported using an arbitrary rating scale. The machine was run for 100 movements.

<u>Rating scale</u>

5-No pilling
4-Slight pilling
3-Moderate pilling
2-Severe pilling
1-Very severe pilling

Cloth pilling

Pilling resistance of the samples was tested using Martindale tester as directed under ASTM D-4970.

<u>Rating scale</u>

5-No pilling
4-Slight pilling
3-Moderate pilling
2-Severe pilling
1-Very severe pilling

Statistical analysis

The results acquired were subjected to statistical analysis by using WASP (Web Agri-Stat Package) and one-way ANOVA technique.

RESULTS AND DISCUSSIONS

Table 1 shows the values for cloth stiffness. It was found to be highest in the woven Muga control fabric both in warp and weft direction (3.94, 2.94) followed by Muga × Tencel 30s in warp direction (2.58) and in weft direction by Tencel 20s × Muga (2.28) . The least value was observed in Tencel control sample both in warp and weft direction (1.56, 2.02). The results were found to be significant between the fabrics at 5 per cent level. Similar trend was observed for the directions of the samples in warp and weft as well as between the product and between the samples and its directions. The constructional features affecting the stiffness of a cloth are nature of the fibre, yarn type, type of weave, yarn count, cloth weight, cloth thickness and finish applied. Lower value of cloth stiffness gives fuller feel, opposite to thin papery feel. Similar results were found by Anjali *et.al.*[1].

A perusal of table 2 revealed that highest crease recovery was observed in warp way of Tencel 20s × Muga (106) followed by Muga × Tencel 20s (105), Tencel control (104) and Muga × Tencel 30s (104). The least was found in Muga control sample (98). In weft direction the highest value was noticed in Muga × Tencel 30s (103) followed by Muga × Tencel 20s (102), Tencel 20s × Muga (101) and the least value was Muga control (97). Further, these results were found to be significant at 5 per cent level. Since Tencel is a regenerated cellulosic as cellulosic materials are susceptible to creasing. The tensile elongation also plays a relatively small part in elastic recovery. The bending of the fibres or filaments which takes place during creasing leads to an extension of the cellulose on the upper surface and a compression on the under surface. Similar findings were observed in a study carried out by Momita and Satwinder[6].

Table 3 showed that the highest drape coefficient (32.97%) was found in Muga control fabric sample followed by Muga × Tencel 30s (32.76 %) and Muga × Tencel 20s (32.57) respectively. The least drape percentage was obtained in Tencel control fabric with 31.90 per cent. The results between the samples were found to be significant at 5 per cent level which may be due to combined effect of several factors such as stiffness, flexural rigidity, weight, thickness *etc.* Stiffness, an attribute of fabric hand is one of the most important factors determining draping quality of fabric, for example, soft fabric drapes closer to the body forming ripples whereas stiff fabric drapes away from the body. Stiffness of fabric depends upon geometrical parameters of the fabric. These findings are in line with the results of Govardhana *et al.*[4].

Table 4 depicts the tensile strength values of Muga and Tencel union fabrics. Tencel 20s × Muga showed the highest (32.84kgf) breaking strength in warp way followed by Tencel × Tencel (28.6 kgf) and the least in Muga × Tencel 30s (23.68kgf). In weft direction the highest value was obtained by Tencel × Tencel (69.04 kgf) followed by Muga × Tencel 30s (37.88 kgf) and the least in Muga × Tencel 20s (24.52 kgf). The statistical analysis of these results showed a significant difference at 5 per cent level between the samples and its directions of warp and weft. The product of the samples and the directions were also found to be significant which may be due to fibre content, yarn type, yarn count, fabric sett, and method of fabric construction of the samples. The samples which contain Tencel yarn showed higher values of breaking strength which may be due to Tencel yarn being coarser each constituent fibre share more load than finer yarn, thus increasing the breaking strength of the fabric. Yarn crimp also contributes to strength of the fabric. When a test strip of fabric is extended in one direction crimp is removed and the threads straightened out. This causes the threads at right angles to the loading direction to be crimped further. ‘Crimp interchange’ is said to take place. The specimen loses its original rectangular shape and ‘waisting occcurs’, *i.e.* the middle region of the strip contracts. Therefore extension will be high relatively per unit increase in load in the early stages of the test, most of which will be due to removal of the crimp[2].

It is observed from table 4 that the highest value of cloth elongation in warp way was found in Muga × Tencel 20s (34.97%) followed by Muga × Tencel 30s (34.59%). The least was exhibited by Tencel 20s × Muga (9.15%) sample. Except the value of Tencel 20s × Muga (9.15) all the samples showed a greater values when compared to both the control samples of Muga and Tencel. In weft way the highest value was found in Tencel 20s × Muga (36.86%) which contained Muga yarn in weft direction followed by the control sample of Muga × Muga (24.42) and the least was shown in Muga × Tencel 30s (10.78) which was having Tencel yarn as weft. These values between the samples were found to be significant at 5 per cent level and between its directions of warp and weft. Similar trend was observed between the product of samples and its directions in warp and weft way. The elongation percentage of the samples shows a significant increase with the content of Muga yarn in its directions either warp or weft as given in table 13. This may be due to the yarn tension or extension due to crimp causes crimp interchange. Thus, more crimp helps to extend the fabric more. Warp and weft tension increasing during the weaving process limits the elongation of the fabric making elongation percentage to decrease. This may be due to fractions of cellular structure and microfibrils of the fibre. These results are in line with the findings of Hossain *et al.*[5].

Table 5 revealed the results of abrasion resistance of the test samples. All the fabrics showed high resistance to abrasion except Tencel control and Tencel 20s × Muga samples showed slight abrasion. This may be due to fibre type such as high elongation percentage elastic recovery and work of rupture are considered as important factors. Since Muga silk yarn is a filament which attributes higher resistance to abrasion as longer fibres incorporated into fabric confer better abrasion resistance, because they are harder to remove from yarn. Yarns with high crimp take the brunt of abrasive action. This is because crowns formed as the yarn bends round a transverse thread will protrude from the fabric surface and meet the destructive abrasive agent first. The other set of yarns lying in the centre of the fabric will only play their part in resisting abrasion when the highly crimped threads are nearly worn through[2].

A perusal of table 6 illustrates pilling appearance of test samples. Slight pilling was exhibited by Tencel control and Tencel 20s × Muga fabrics. Almost all the union fabrics samples revealed excellent rating (s) for pilling property. This is because of higher number of ends and picks per inch which causes tight and compact structure of fabrics and thus help in reducing pills. Also, type of weave influences pilling tendency, such as more pilling is observed in twill and satin weaves than plain weave. These results were on par with the findings of Anjali *et al.*[1].

Table 1: Cloth stiffness of Muga and Tencel union fabrics

Sl. No.	Samples	Cloth Stiffness (cm)	
		Warp way	Weft way
1.	Muga control	3.94	2.94
2.	Tencel control	1.56	1.01
3.	Muga×Tencel20s	2.42	2.14
4.	Muga×Tencel30s	2.58	2.04
5.	Tencel 20s× Muga	1.94	2.28

Factors	S. Em. ±	C. D. @ 5%	C. V. (%)
A - Union fabrics	0.033	0.097*	4.49
B - Warp and Weft	0.022	0.062*	
A × B - Union fabrics × Warp and Weft	0.44	0.138*	

Table 2: Cloth crease recovery angle of Muga and Tencel union fabrics

Sl. No.	Samples	Crease Recovery angle (degree)	
		Warp way	Weft way
1.	Muga control	98	97
2.	Tencel control	104	100
3.	Muga×Tencel20s	105	102
4.	Muga×Tencel30s	104	103
5.	Tencel 20s× Muga	106	101

Factors	S. Em. ±	C. D. @ 5%	C. V. (%)
A - Union fabrics	1.77	5.42*	4.05
B - Warp and Weft	1.11	3.43*	
A × B - Union fabrics × Warp and Weft	2.43	7.67*	

Table 3: Drape coefficient of Muga and Tencel union fabrics

Sl. No.	Samples	Nodes	Drape coefficient (%)
1.	Muga control	4	32.97
2.	Tencel control	7	31.90
3.	Muga×Tencel20s	6	32.57
4.	Muga×Tencel30s	5	32.76
5.	Tencel 20s× Muga	6	32.6

Variables	S. Em. ±	C. D. @ 5%	C. V. (%)
Muga control	0.48	1.5*	2.56
Tencel control	0.50	1.5*	3.02

Table 4: Cloth tensile strength and elongation of Muga and Tencel union fabrics

c	Samples	Tensile strength (kgf)		Elongation (%)	
		Warp way	Weft way	Warp way	Weft way
1	Muga × Muga	26.86	25.32	15.27	24.42
2	Tencel control	28.6	69.04	10.95	10.99
3	Muga × Tencel 20s	24.66	24.52	34.97	11.98
4	Muga × Tencel 30s	23.68	37.88	34.59	10.78
5	Tencel 20s× Muga	32.84	35.66	9.15	36.86

ANOVA table for cloth tensile strength

Factors	S. Em. ±	C. D. @ 5%	C. V. (%)
A - Union fabrics	0.66	2.04*	3.03
B - Warp and Weft	0.43	1.29*	
A × B - Union fabrics × Warp and Weft	0.97	2.89*	

ANOVA table for cloth elongation

Factors	S. Em. ±	C. D. @ 5%	C. V. (%)
A - Union fabrics	0.44	1.24*	3.88
B - Warp and Weft	0.27	0.79*	
A × B - Union fabrics × Warp and Weft	0.56	1.76*	

Table 5: Cloth abrasion resistance of Muga and Tencel union fabrics

Sl. No.	Samples	No. of cycles	Ratings
1	Muga×Muga	100	5
2	Tencel control	100	4
3	Muga×Tencel 20s	100	5
4	Muga×Tencel 30s	100	4
5	Tencel 20s× Muga	100	4

<u>Rating scale</u>

5-No pilling
4-Slight pilling
3-Moderate pilling
2-Severe pilling
1-Very severe pilling

Table 6: Cloth pilling of Muga and Tencel union fabrics

Sl. No.	Samples	Ratings
1	Muga control	5
2	Tencel control	4
3	Muga × Tencel 20s	5
4	Muga × Tencel 30s	5
5	Tencel 20s × Muga	4

Rating scale

5 - No pilling
4 - Slight pilling
3 - Moderate pilling
2 - Severe pilling
1 - Very severe pilling

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