Study On Bamboo Fibre Vs Cotton Fibre Characteristics for Spinning

S.Subramanian
Department of Textile Technology, Rukmini Shanmugam Polytechnic College, Madurai

***Abstract*- Bamboo fibre has unique function of anti-bacteria, which make it suitable for underwear, t-shirt and socks. It has also wide scope in the field of hygiene materials such as sanitary napkin, masks, mattress, bandages, surgical cloths, surgical gown, absorbent pads and food packing, etc.**

Due to anti-ultraviolet radiation characteristics of bamboo fibre, it is suitable for making summer clothing for the protection of human skin against damages of UV radiation (UVR). Wallpapers, curtains and sofa covers are produced from bamboo fibre because it absorbs UV radiation of different wavelengths from atmosphere. Hence it protects human skin from radiation.

Exposure of human skin to UV radiation of different wavelengths causes some serious skin problems such as ageing of skin, roughening, wrinkles, blotches, and sagging. And also sometimes it leads to skin cancer. The intensity of UV radiation depends on sun's altitude, geographical position, atmospheric conditions, etc. With reference to above said skin problems. Bamboo fabric can protect human skin strongly from damages of UV radiation, because it naturally possesses anti-UV radiation characteristics.

Knitting yarns require high work of rupture, good resiliency, high ratio of primary to secondary creep, high elongation at break, low flexural and tensile resistance and adequate tenacity, etc. In knitted fabric use of doubled yarn with soft twisted singles enhances the properties. There is an overall improvement in tensile properties, hairiness, wet and thermal stability, pilling resistance and air permeability. The performance of doubled yarn in knitted fabrics even excels that of single yarn of same count.

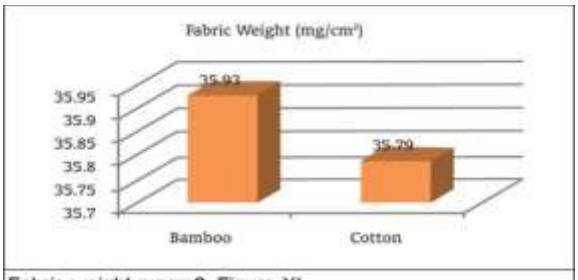
FABRIC COMFORT: Cotton v/s bamboo

Bamboo yarn shows better results in case of strength, elongation and hairiness, and while bamboo fabric is more extensible than cotton fabric, cotton fabric shows more stiffness and geometrically rougher surface, reveal Ajay Rathod and Avinash Kolhatkar.

Bamboo plants are commonly cultivated in Asian countries. It is one kind of grass with hollow and woody stem. There are so many varieties of bamboo plant across the world. Nowadays, bamboo is widely used in the field of building and construction because of its toughness and other properties

A few decades ago, bamboo was traditionally used for making a variety of household goods such as furniture, sporting goods, handbags, flooring and cutting board, etc. Nowadays, due to developments in manufacturing processes, it is possible to produce fibre from bamboo stem, which has remarkable properties for its use in yarn and fabric.

Bamboo fibre is a natural, eco-friendly fibre. It is regenerated cellulosic fibre produced from pulp of bamboo stem, most commonly cultivated in Asian countries. It possesses unique properties such as anti-UV radiation; anti-bacterial, breathable, cool and soft handle, etc. Due to various micro gaps and micro holes in cross section it has better moisture absorption. Bamboo fabric absorbs and evaporates sweat very easily, hence it gives a comfortable feel. It can be spun into 100 per cent bamboo yarn and also blended with natural and man-made fibres like cotton, polyester, silk, etc.



Fabric-weight-mgcm2_Figure-XI

Fibre properties

Properties	Bamboo	Cotton
Strength (gm/tex)	34.3	35.6
Elongation (%)	16.0	5.3
Short Fibre Index	5.58	9.35
Uniformity Index (%)	92.7	80.8
UHML(mm)	38.745	29.539
ML (mm)	35.62	24.259
Moisture (%)	6.5	7.5
Micronaire	4.0	4.0

Table 1: Physical Properties of Bamboo and Cotton Fibre

Table 1 illustrate the major differences in properties

exhibited by the cotton and bamboo fibres. Cotton fibre shows higher strength and moisture per cent. And bamboo fibre shows higher elongation and uniformity index (percentage), etc.

YARN SAMPLE PREPARATION

Yarn samples of 40sNe are produced from bamboo and cotton fibre by using above mentioned fibre characteristics.

The knitted fabric samples of bamboo and cotton are produced on rib knitting machine with following specifications. The construction particulars of the experimental fabrics are listed in Table II.

Sample type	Structure	Wales per inch	Coarse per inch
Bamboo fabric	Rib	35	19
Cotton fabric	Rib	29	19

Table-II: Fabric Specifications

EXPERIMENTAL METHODS:

Fibre properties:

Fibre properties such as strength, elongation, micronaire and uniformity index and moisture per cent, etc., of bamboo and cotton fibre are measured on Uster HVI SW

Yarn properties:

Yarn properties such as strength and elongation are measured on Uster Tensorapid Tester (3 V 6.1) with gauge length—20 inches, velocity of jaw—2,000 mm/min. And unevenness, imperfection and hairiness are measured on IQ Qualicentre (version A 3.0.2) with 400 m test length.

Low stress mechanical properties:

Low stress mechanical properties of fabric are tested on KAWABATTA Instrument.

- KES-FB1 – Tensile and Shear Properties, KES-FB2 – Bending Properties
- KES-FB3 – Compression Properties, KES-FB4 – Surface Properties

Yarn properties

Properties	Bamboo Yarn	Cotton Yarn
Strength (Rkm Kgf*Nm)	17.03	16.25
Elongation (%)	13.28	6.436
Unevenness (U %)	10.56	10.41
Hairiness (H3)	392.6	827.87
Coefficient of variation (CVm %)	13.34	13.3
Breaking Force (N)	2.47	2.314
Breaking Work (N.cm)	10.06	4.2235

Table-III: Yarn properties

Figures I, II and Table-III illustrate the major differences in properties exhibited by the bamboo and cotton yarns. It is seen from the Table-III that bamboo yarn shows significantly higher strength and elongation as compared to cotton yarn. It also shows significantly lower hairiness. But unevenness and coefficient of variation of both samples are not differing significantly. Hence bamboo yarn is better from the physical properties point of view.

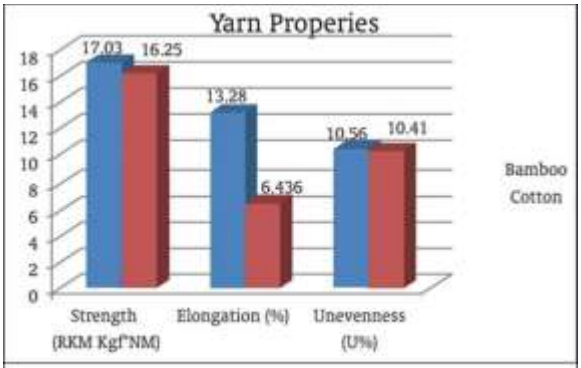


Figure-I

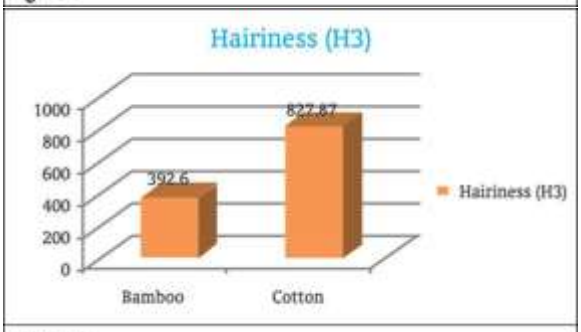


Figure-II

Sample		LT	WT (g.cm/ cm2)	RT (%)	EMT (%)
Bamboo Fabric	Avg.	0.833	4.64	24.76	23.63
Cotton Fabric	Avg.	0.821	4.32	35.36	22.50

Table-IV

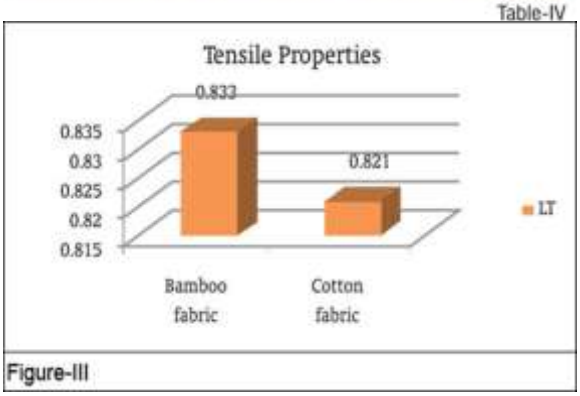


Figure-III

Tensile properties using tensile and shear tester (KES-FB1)

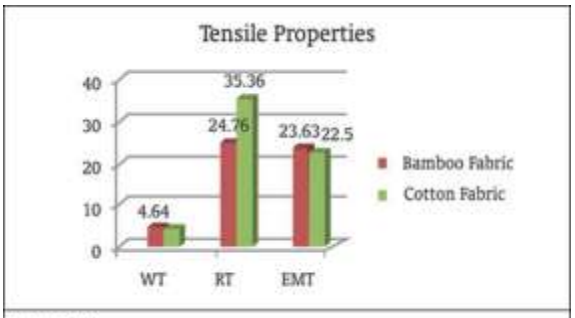


Figure-IV

Table-IV shows results of tensile properties, the higher value of EMT is better. The EMT values of cotton and bamboo fabric sample are 22.50 per cent and 23.63 per cent respectively, in which bamboo fabric sample shows 4.78 per cent higher EMT than cotton fabric sample; hence bamboo fabric is more extensible in nature than cotton fabric.

LT represents linearity of load – extension curve. A higher value of LT is supposed to be better. In this contest, bamboo and cotton fabric samples have 0.833 and 0.821 LT respectively. From linearity of load – extension curve point of view bamboo sample is better than cotton sample; the former showing 30 per cent higher LT than cotton sample.

The differences observed in tensile properties of fabrics can be attributed to the difference in the strength and elongation of two yarns.

Shear properties using tensile and shear tester (KES-FB1)

Shear properties using tensile and shear tester (KES-FB1)

Sample		G (g/cm.deg)	2HG (g/cm)	RT (%)
Bamboo Fabric	Avg.	0.77	3.85	3.96
Cotton Fabric	Avg.	0.52	2.37	2.33

Table-V

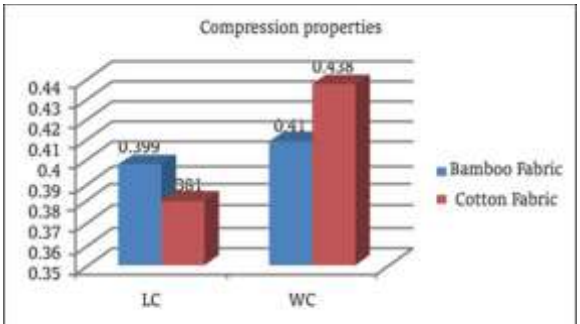


Figure-IX

Table-V shows results of shear rigidity (G). The shear rigidity values of bamboo and cotton sample are 0.77 and 0.52 respectively. Bamboo sample shows 32.46 per cent higher shear rigidity than cotton sample. Hence cotton sample is the best from the shear rigidity point of view. Generally shear rigidity of fabric depends on yarn interaction. 2HG is the hysteresis of shear force at 0.5 degree of shear angle and 2HG5 is the hysteresis of shear force at five degree of shear angle.

Bending properties using pure bending tester (KES-FB2)

Sample		B (g.cm²/cm)	2HB (g .cm/cm)
Bamboo Fabric	Avg.	0.0576	0.1284
Cotton Fabric	Avg.	0.0784	0.1347

Table-VI

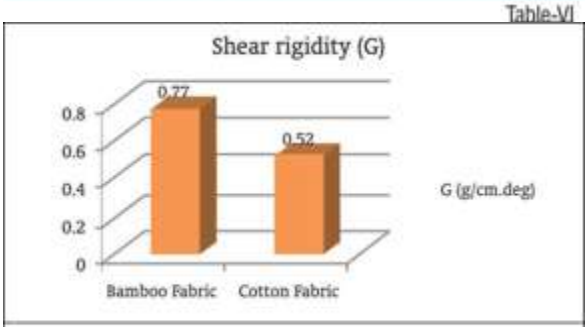


Figure-V

Table-VI shows results of bending rigidity (B). The bending rigidity values of bamboo and cotton fabric samples are 0.0576 and 0.0784 respectively. Higher the value of B higher will be the stiffness of fabric. Cotton fabric sample shows 26.53 per cent higher bending rigidity than bamboo fabric. Hence it is stiffer than bamboo fabric. Difference in bending rigidity of two fabrics is because of difference in fibre type, twist factor and yarn bulk, etc.

Surface properties using surface tester (KES-FB4)

Surface properties using surface tester (KES-FB4)

Sample		MIU	MMD	SMD (μm)
Bamboo Fabric	Avg.	0.352	0.0283	12.71
Cotton Fabric	Avg.	0.345	0.0213	13.00

Table-VII

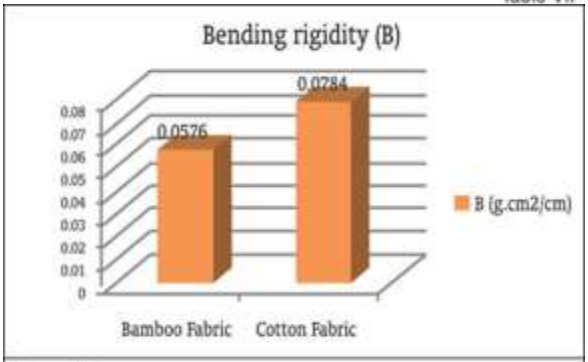


Figure-VI

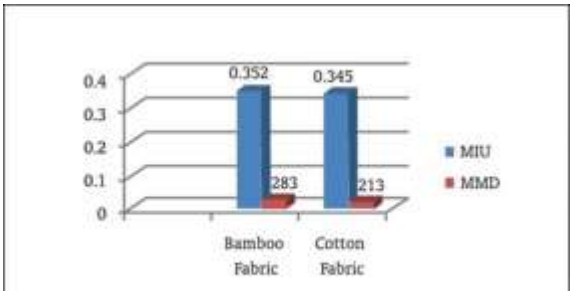


Figure-VII

Table-VII shows results of coefficient of friction (MIU). Higher value of MIU corresponds to higher friction, the values of coefficient of friction of cotton and bamboo fabric sample are 0.345 and 0.352 respectively. Bamboo fabric sample has 1.98 per cent higher value of MIU than cotton fabric; it means bamboo fabric has higher friction than cotton fabric, hence it means less comfort. MMD is mean deviation of MIU; higher value corresponds to larger variation of friction. SMD is geometrical roughness; higher value corresponds to geometrically rough surface. And hence cotton fabric has geometrically rougher surface.

Compression properties using compression tester (KES-FB3)

Compression properties using compression tester (KES-FB3)

Sample		LC	WC (g.cm/cm²)	RC (%)
Bamboo Fabric	Avg.	0.399	0.410	40.18
Cotton Fabric	Avg.	0.381	0.438	41.20

Table-VIII

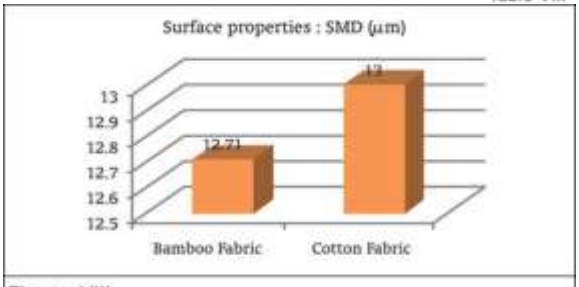


Figure--VIII

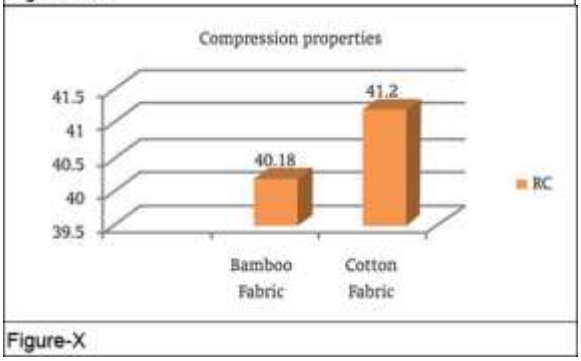


Figure-X

The values of linearity of compression (LC) are shown in Table-VIII. The values of linearity of compression of bamboo and cotton fabric are 0.399and 0.381 respectively, bamboo fabric showing 4.72 per cent higher linearity of compression than cotton fabric.

Compression resilience (RC) values of bamboo and cotton fabric are 40.18 and 41.20 respectively; cotton fabric showing 2.47 per cent higher compression resilience than bamboo fabric. Compression resilience of fabric depends on the compression behaviour of yarn and fabric thickness.

As shown in Table-VIII, WC is Compressional energy; higher value of WC corresponds to higher compressibility. Hence cotton fabric is more compressible than bamboo fabric because of greater bulk and covering properties of cotton yarn.

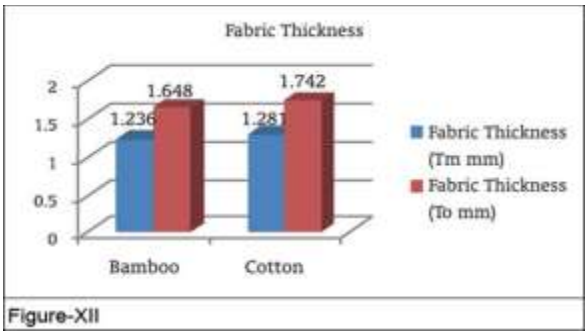
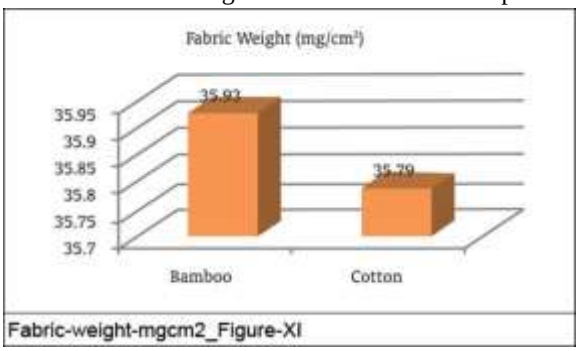


Figure-XII

As shown in Figure-b, fabric weights of cotton and bamboo fabric sample are 35.79 and 35.93 mg/cm2 respectively. Bamboo fabric sample has 0.389 per cent more fabric weight than cotton fabric sample



Fabric-weight-mgcm2_Figure-XI

Fabric thickness (mm)

At Tmax (mm)

As shown in Figure-c, fabric thickness of bamboo and cotton fabric sample are 1.236 mm and 1.281 mm respectively. Cotton fabric sample has 3.51 per cent more thickness than bamboo fabric sample.

At To (mm)

Figure-c shows results of thickness, the fabric thickness of bamboo and cotton fabric sample are

1.648 mm and 1.742 mm respectively. Cotton fabric sample has 5.39 per cent more thickness than bamboo.

Sr. No	Hand value	Bamboo fabric	Cotton fabric
1	Koshi	2.11	1.57
2	Numeri	2.91	4.53
3	Fukurami	2.41	3.84
4	THV	1.13	1.78

Table-IX: Hand value

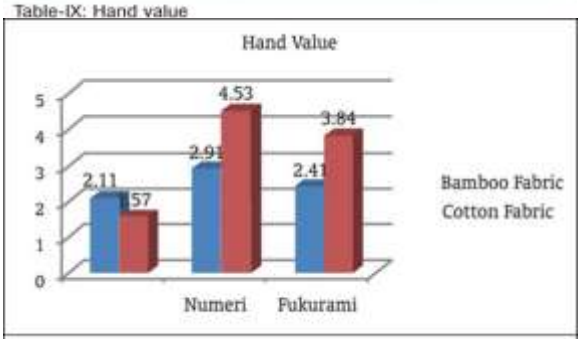


Figure -XIII-Hand-Value-H.V.10-Strong-1Week

Koshi (stiffness) mainly relates to bending stiffness. A fabric having a compact weave density and made from springy and elastic yarn gives a high koshi value. Numeri is the smoothness of the fabric. Fukurami (fullness and softness) is a feeling coming from a combination bulky and rich feeling and it is mainly governed by bulk and compressional behaviour of fabric

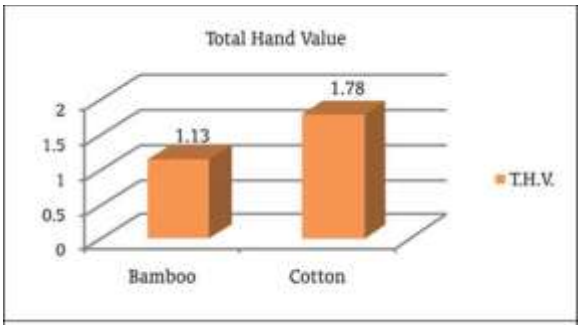


Figure--XIV-Total-Hand-Value-(T.H.V)-5-Excellent-1-Poor.

Total hand values (THV) of bamboo and cotton fabric sample are 1.13 and 1.78 respectively, showing that the handle of cotton fabric is better than bamboo fabric.

CONCLUSION

From Kawabatta evaluation, it can be concluded that, bamboo fabric shows 4.78 per cent higher EMT than cotton fabric, and hence bamboo fabric is more extensible than cotton fabric. But cotton fabric sample has 26.53 per cent higher bending rigidity than bamboo fabric; hence it is stiffer than bamboo fabric. MIU value of bamboo fabric is 1.98 per cent higher than cotton fabric; it means that bamboo fabric shows higher friction than cotton fabric. SMD is geometrical roughness; higher value corresponds to geometrically rough surface. And hence cotton fabric has geometrically rougher surface. WC is compressional energy; higher value of WC corresponds to higher compressibility, hence cotton fabric is more compressible than bamboo fabric.

REFERENCES

[1] A.R.Harrock and S.C.Annand, Handbook of Technical Textiles, 1st ed., Florida USA: Woodhead Publishing, CRC press,WP1047, 2012
[2] US Census Bureau, International data base, June 2010 update
[3] David Rigby Associates in Tech Textiles
[4] www.insulation-shop.net
[5] www.keywordsuggest.org
[6] www.upcscavenger.com
[7] www.world-trades.com
[8] http://textilelearner.blogspot.com.tr/2014/04/applications-of-agro-textiles.html
[9] http://www.ttoutlook.com
[10] http://www.bonar.com/media/1562/brochure-duracover-english.pdf
[11] http://ec.europa.eu/environment/life/publications/lifepublications/compilations/documents/envcompilation09.pdf
[12] http://www.texinov.fr/en/textile-engineering/industry
[13] http://www.indiantextilejournal.com/articles/FAdetails.asp?id=4709