

ANALYSIS OF PHYSICAL CHARACTERISTICS OF BAMBOO FABRICS

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Abstract

This paper presents a study on physical properties of bamboo & bamboo-cotton(50:50) blended yarn fabrics which are commonly used for apparel production. Yarns of 4 different counts such as 20, 24, 30 & 40Ne were used as warp & Weft in bamboo & bamboo-cotton blended yarn fabric. All fabrics were produced in plain weave with 50 ppi. Various test such as breaking strength, elongation, fabric weight, thickness and abrasion resistance have been carried out to study the performance of bamboo & bamboo-cotton(50:50) blended yarn fabrics. The experimental result indicates that 100% bamboo fabric exhibits higher breaking strength than bamboo-cotton (50:50) blended yarn fabric. Higher elongation values are noticed in the case of 100% bamboo fabric than bamboo-cotton (50:50) blended yarn fabrics. It is also found that 100% bamboo fabric exhibits higher tearing strength than bamboo-cotton (50:50) blended yarn fabric of similar specifications. The 100% bamboo fabric exhibits higher thickness than bamboo-cotton (50:50) blended yarn fabric of similar specifications. The cover factor of bamboo-cotton (50:50) blended yarn fabric is higher than bamboo fabric. It is found that 100% bamboo fabric exhibits better performance than bamboo-cotton (50:50) blended yarn fabrics.

Keywords: Analysis, Bamboo, Strength, Plain Weave, Pick Density.

1. INTRODUCTION

Bamboo fibre has been used various application such as building and construction, decoration, slope maintenance and high performance composites for the past many years. Regenerated bamboo fibres have characteristics mechanical properties of superior tensile strength, excellent UV protection, antibacterial and biodegradable characteristics, high moisture absorption, softness, brightness and high flexibility under flexible and compressive loads. With its high moisture absorption capacity, breathability and fast drying behavior, regenerated bamboo cellulose fibre ensures excellent comfort in various applications. Currently regenerated bamboo fibre is used in intimate apparels, hygienic products and sanitary materials, nonwovens and home furnishings [1].

Bamboo textile products are having high demands in the market because of their anti bacterial nature, biodegradable properties, high moisture absorption capacity, softness and UV protective capability [2]. Bamboo has much to offer in its raw form. Its geographical range is wide spread and its uses are numerous. As a grass, it has a diverse network of growth patterns and can flourish in harsh climates. Nevertheless, many animal and plant species depend on bamboo [3].

At present, there are two ways to utilize bamboo in the textile industry. One is to produce natural fibre from bamboo by chemical and physical treatment. The other method is to spin the regenerated fibre after the bamboo is retted into bamboo pulp. Since the latter has similar processing method of viscose. There are some advantages to the development of bamboo fibre for textiles. First, bamboo fibres are an

environmental friendly fibre extracted from bamboo, which is renewable, fast growing, degradable and does not occupy cultivated land [4].

Bamboo is an antibacterial; relatively smooth fibre with low pilling and wrinkling, as well as high moisture sweat absorption, due to the micro gaps in its profile. Bamboo fabrics require less dyestuff than cotton fabrics in order to be dyed to the level desired, as they absorb the dyestuff better and faster and show the colour better [5].

Life standard is nowadays getting higher. The demands of people in all areas are increasing as well as the requirements regarding new textile materials with new or improved properties which are important for the required higher comfort or industrial use [6]. One of the most important aspects of clothing is comfort. Properties like thermal resistance, air permeability, water vapour permeability and liquid water permeability are critical for the thermal comfort of a clothed body. Comfort plays a vital role in the selection of apparel [7].

The demands from fabrics have changed with developments in technology and the rising living standards. Now the requirement is not only style and durability but also clothing comfort which includes psychological, sensorial and thermo-physiological comfort. It is evident that fibre type, yarn properties, fabric structure, finishing treatments and clothing conditions are the main factors affecting clothing comfort. Bamboo fibre is a regenerated cellulosic fibre produced from bamboo. The type of bamboo used for apparel is moso bamboo. Starchy pulp is produced from bamboo stems and leaves through a process of alkaline hydrolysis and multi

phase bleaching. Further chemical processes produce bamboo fibre. They have got numerous unique properties like inherent anti-bacterial property [8].

With the growing demand for more comfortable, healthier and environmentally friendly products, efforts in research and development activities in the textile industry have focused on the utilization of renewable and biodegradable resources as well as environmentally sound manufacturing processes in textiles. In this respect, a new kind of regenerated fibres which are an alternative to conventional ones[9]. An important area of textile is healthcare and hygiene sector among other medical applications. The range of products includes both disposable and non disposable items such surgical gown, mask, surgical drape, towels, gloves baby diapers, sanitary napkins and so on used in hospitals. Bamboo fibre has an excellent property that makes it ideal for processing into textiles. It is highly water absorbent, able to take up three times of its weight of water. Bamboo fibre has natural effect of sterilization, moisture vapour transmission property and easy drying. Therefore, this fibre will not cause skin allergies and its application in sanitary materials such as baby diaper, absorbent pads and sanitary towels is found to increase [10]. Hence, in the present work an attempt has been made to study and analyze the properties of 100% bamboo & bamboo – cotton (50:50) blended yarn fabrics.

2. MATERIALS AND METHODS

2.1. Materials

2.1.1 Fibre Properties

Table-1 Physical Properties of Bamboo Fibre

Physical Properties of Bamboo Fibre	
Strength (g/tex)	34.3
Elongation (%)	16.0
Short Fibre Index (12.7mm)	5.58
Uniformity Index (%)	92.7
UHML(mm)	38.745
ML (mm)	35.62
Moisture (%)	6.5
Micronaire	4.0

Table-1 shows physical properties of bamboo fibre. Strength (gm/tex), Elongation (%), Short fibre index, Uniformity index, Moisture (%) and Micronaire are 34.3, 16.0, 5.58, 92.7, 6.5 and 4.0 respectively.

2.1.2 Production of 100% Bamboo & Bamboo: Cotton (50:50) Fabric

Yarns of 20, 24, 30, 40Ne of 100% bamboo & bamboo-cotton (50:50) blend were used as warp & weft in plain fabric of 50 ppi & 75 epi. These fabric samples were produced with following fabric specifications on sample weaving machine.

Table-2 Specifications of Fabric

Material	Weave	PPI	EPI	WP & WF Count
100% Bamboo	Plain	50	75	20,24,30,40
Bamboo-Cotton (50:50)	Plain	50	75	20,24,30,40

2.2 Experimental Methods

2.2.1 Fibre Properties

Fibre properties such as strength, elongation, micronaire and uniformity index and moisture % etc. of bamboo are measured on Uster HVI SW 3.1.1.0 version.

2.2.2 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 2000 mm / min. While unevenness, imperfection and hairiness were measured on IQ Qualicentre (version A 3.0.2) with 400 meter test length.

2.2.3 Fabric Properties

Physical properties of fabric such as fabric mass(ASTM-D3776:2009), thickness(ASTM D1777:2007), tearing strength (ASTM D1424:2009), breaking strength (IS 1969-1985, R.A.2006), elongation (IS 1969-1985, R.A.2006), abrasion resistance (ASTM D4966-98, R.A.2007) etc were measured as per standards testing methods after conditioning the specimens at 65% RH and 27+/- 2°C for 24 Hrs.

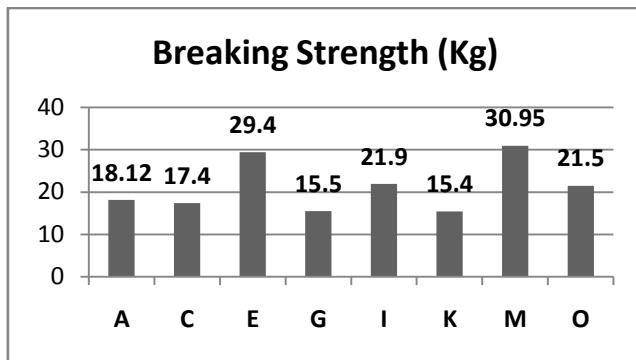
3. RESULTS AND ANALYSIS

3.1 Physical Properties of Fabric (Plain Fabric- 50 ppi)

3.1.1. Breaking Strength (Kg)

Table 3.1: Breaking Strength

Code	Sample Particulars PPI 50	Breaking Strength
A	20 Ne 100% Bamboo	18.12
C	20 Ne 50:50% Bamboo/Cotton	17.4
E	24 Ne 100% Bamboo	29.4
G	24 Ne 50:50 Bamboo/Cotton	15.5
I	30 Ne 100% Bamboo	21.9
K	30 Ne 50:50% Bamboo/Cotton	15.4
M	40 Ne 100% Bamboo	30.95
O	40 Ne50:50 Bamboo/Cotton	21.5



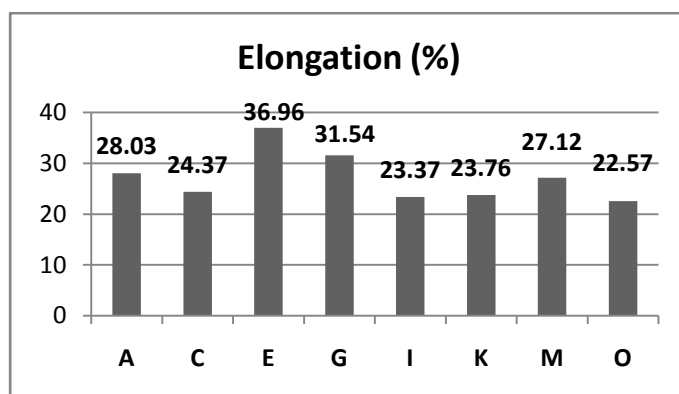
Graph 3.1: Breaking Strength

Table 3.1 & Graph 3.1 show results of breaking strength of 100% bamboo & bamboo-cotton (50:50) blended yarn fabrics. The experimental result shows that, bamboo fabric exhibits higher breaking strength than bamboo-cotton (50:50) blended yarn fabric. This result may be attributed to higher tenacity of bamboo fibre. The breaking strength is considerably higher for sample M compared with those for other samples.

3.1.2. Elongation (%)

Table 3.2: Elongation%

Code	Sample Particulars PPI 50	Elongation (%)
A	20 Ne 100% Bamboo	28.03
C	20 Ne 50:50% Bamboo/Cotton	24.37
E	24 Ne 100% Bamboo	36.96
G	24 Ne 50:50% Bamboo/Cotton	31.54
I	30 Ne 100% Bamboo	23.37
K	30 Ne 50:50% Bamboo/Cotton	23.76
M	40 Ne 100% Bamboo	27.12
O	40 Ne50:50 Bamboo/Cotton	22.57



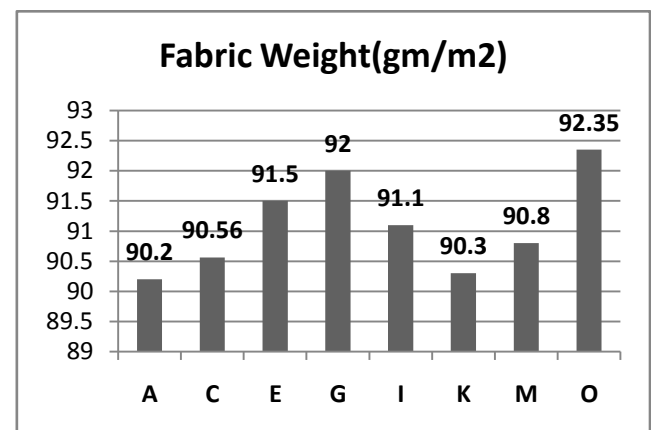
Graph 3.2: Elongation%

Table 3.2 & Graph 3.2 show results of elongation % of 100% bamboo & bamboo-cotton (50:50) blended yarn fabrics. The experimental result shows that, bamboo fabric exhibits higher elongation than bamboo-cotton (50:50) blended yarn fabric. This result may be attributed to higher elongation of bamboo fibre. From the results, it is observed that higher elongation values are noticed in the case of 100% bamboo fabric than bamboo-cotton (50:50) blended yarn fabrics.

3.1.3. Fabric Weight (gm/m²)

Table 3.3: Fabric Weight

Code	Sample Particulars PPI 50	Fabric Weight
A	20 Ne 100% Bamboo	90.2
C	20 Ne 50:50% Bamboo/Cotton	90.56
E	24 Ne 100% Bamboo	91.5
G	24 Ne 50:50 Bamboo/Cotton	92
I	30 Ne 100% Bamboo	91.1
K	30 Ne 50:50% Bamboo/Cotton	90.3
M	40 Ne 100% Bamboo	90.8
O	40 Ne50:50 Bamboo/Cotton	92.35



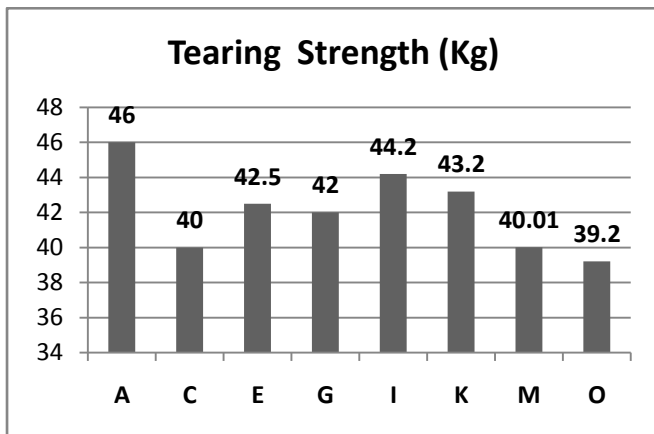
Graph 3.3: Fabric Weight

The results of fabric weight of 100% bamboo & bamboo-cotton (50:50) blended yarn fabrics are shown in table 3.3 & graph 3.3. The results indicate that fabric weight of bamboo-cotton (50:50) blended fabric is higher than 100% bamboo fabric. This may be due to difference in linear densities of fibres.

3.1.4. Tearing Strength (kg)

Table 3.4: Tearing Strength

Code	Sample Particulars PPI 50	Tearing Strength
A	20 Ne 100% Bamboo	46
C	20 Ne 50:50% Bamboo/Cotton	40
E	24 Ne 100% Bamboo	42.5
G	24 Ne 50:50 Bamboo/Cotton	42.
I	30 Ne 100% Bamboo	44.2
K	30 Ne 50:50% Bamboo/Cotton	43.2
M	40 Ne 100% Bamboo	40.01
O	40 Ne50:50 Bamboo/Cotton	39.2



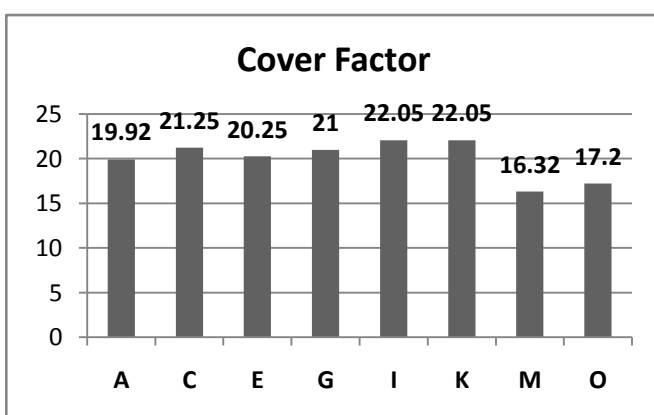
Graph 3.4: Tearing Strength

Table 3.4 & graph 3.4 shows results of tearing strength of 100% bamboo & bamboo-cotton (50:50) blended yarn fabrics. The experimental result shows that sample A has higher tearing strength when compared to all other samples. It is also found that 100% bamboo fabric exhibits higher tearing strength than bamboo-cotton (50:50) blended fabric of similar specifications.

3.1.5. Cover Factor

Table 3.5: Cover Factor

Code	Sample Particulars PPI 50	Cover Factor
A	20 Ne 100% Bamboo	19.92
C	20 Ne 50:50% Bamboo/Cotton	21.25
E	24 Ne 100% Bamboo	20.25
G	24 Ne 50:50 Bamboo/Cotton	21.00
I	30 Ne 100% Bamboo	22.05
K	30 Ne 50:50% Bamboo/Cotton	22.05
M	40 Ne 100% Bamboo	16.32
O	40 Ne50:50 Bamboo/Cotton	17.20



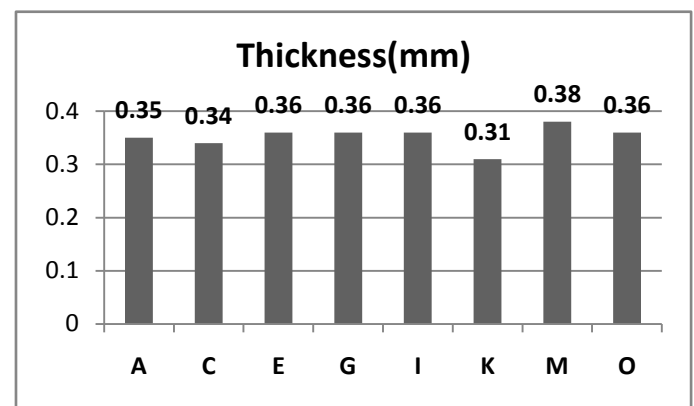
Graph 3.5: Cover Factor

Table 3.5 & graph 3.5 illustrates the values of cover factor of 100% bamboo & bamboo-cotton (50:50) blended yarn fabrics. The experimental results show that, bamboo-cotton (50:50) blended yarn fabrics exhibits better values of cover factor than bamboo fabric. This may be due to higher hairiness of bamboo-cotton (50:50) blended yarn.

3.1.6. Thickness (mm)

Table 3.6: Thickness

Code	Sample Particulars PPI 50	Thickness (mm)
A	20 Ne 100% Bamboo	0.35
C	20 Ne 50:50% Bamboo/Cotton	0.34
E	24 Ne 100% Bamboo	0.36
G	24 Ne 50:50 Bamboo/Cotton	0.36
I	30 Ne 100% Bamboo	0.36
K	30 Ne 50:50% Bamboo/Cotton	0.31
M	40 Ne 100% Bamboo	0.38
O	40 Ne50:50 Bamboo/Cotton	0.36



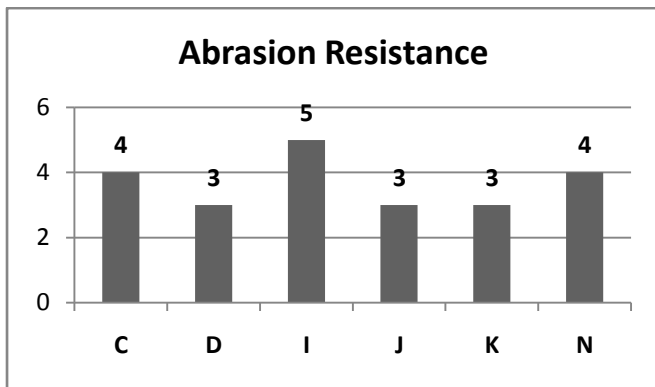
Graph 3.6: Thickness

Table 3.6 & graph 3.6 shows results of thickness of 100% bamboo & bamboo-cotton (50:50) blended yarn fabrics. It is found that 100% bamboo fabric exhibits higher thickness than bamboo-cotton (50:50) blended yarn fabric of similar specifications. This result may be attributed to higher hairiness of 100% bamboo yarn.

3.1.7. Abrasion Resistance

Table 3.7: Abrasion Resistance

Code	Sample Particulars PPI 50	Abrasion Resistance
C	20 Ne 50:50% Bamboo/Cotton,	4
D	20 Ne 100% Bamboo	3
I	30 Ne 100% Bamboo	5
J	30 Ne 50:50% Bamboo/Cotton	3
K	40 Ne 50:50% Bamboo/Cotton	3
N	40 Ne 100% Bamboo	4



Graph 3.7: Abrasion Resistance

As shown in table-3.7 & graph-3.7. The abrasion resistance of 100% bamboo & (50:50) bamboo: cotton blended yarn fabric is 4, 3, 5, 3, 3 and 4 respectively.

4. CONCLUSIONS

The physical characteristics of woven fabrics made from 100% bamboo & bamboo-cotton (50:50) blended yarn have been analyzed.

Bamboo fabric exhibits higher breaking strength than bamboo-cotton (50:50) blended yarn fabric. Higher elongation values are noticed in the case of 100% bamboo fabric than bamboo-cotton (50:50) blended yarn fabrics. It is also found that 100% bamboo fabric exhibits higher tearing strength than bamboo-cotton (50:50) blended yarn fabric of similar specifications. The 100% bamboo fabric exhibits higher thickness than bamboo-cotton (50:50) blended yarn fabric of similar specifications. The cover factor of bamboo-cotton (50:50) blended yarn fabric is higher than bamboo fabric.

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