International Conference on Systems, Science, Control, Communication, Engineering and Technology 2016 [ICSSCCET 2016]

ISBN	978-81-929866-6-1	**VOL**	02
Website	icssccet.org	**eMail**	icssccet@asdf.res.in
Received	25 – February – 2016	**Accepted**	10 - March – 2016
Article ID	ICSSCCET023	**eAID**	ICSSCCET.2016.023

Assessment of Comfort Properties of Eco-Friendly Dyed and Finished Bamboo/Cotton Knitted Fabric for Sportswear

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Abstract: *Technical textiles are textile materials and products mainly produced for their technical function and performance, their aesthetic and decorative properties are of secondary importance. Next to medical textiles, sports textiles are the second fast growing area in technical textiles. Cotton fabric is highly popular to society because of its excellent properties such as regeneration, bio-degradation, softness, affinity to skin, and sweat-absorbing properties. Bamboo is extremely absorbent, it is about sixty percentage more water absorbent than cotton. Bamboo fiber is frequently being used in blends with cotton in textile industry which has got high wet strength. Blending is usually done using 50/50 combinations. A study was conducted using Natural dyed (Annattoo seed) and microencapsulated herbal finished (Eucalyptuscitriodora (Eucalyptus leaf) and Azadirachta indica (Neem) were prepared at 2:1 compositions) single jersey knitted 50:50 bamboo/cotton blends, for their comfort properties. Assessment of unfinished and finished fabrics for comfort properties such as drape co-efficient, air permeability, porosity, liquid moisture management property and water vapour resistance were carried out.*

Keywords: *Sports Textiles, comfort properties, single jersey knitted fabric, 50:50 bamboo/cotton blends, drape co-efficient, air permeability, porosity, liquid moisture management property and water vapour resistance,*

INTRODUCTION

Sportswears are engineered to maximize comfort through moisture management and temperature regulation to enhance the performance level of sports persons and at the same time make them more competitive. To achieve these desirable properties the right choice is the textiles using specialized fibers, yarns, fabric and finishing techniques, (1).From functional point of view, the active sportswear requires super lightweight, low fluid resistance, super-high tenacity and stretch ability. For those who are seeking comfort and healthy pursuit's critical features include thermal regulation, UV resistance, sweat absorption, fast drying, vapour permeability and from aesthetic point softness, surface texture, handle, luster, colour and comfort are important factors, (2).

Comfort is determined by the interaction of the body with its micro climate and its clothing. Consumer demand high level of comfort, design and easy care in all types of clothing. However, in sportswear, where thermo physiological comfort can significantly enhance the performance of the wearer. In recent years, more and more consumer pursuit for comfortable and elegant thin fabrics, usually such kind of fabrics are knitted or woven from two or more than two kinds of material. For sportswear knitting is very common and successful,(3). Water permeability is one of the most important properties, which will affect the thermal insulation, quick liquid absorption and ability to evaporate water while staying dry to the touch, and be capable of transporting perspiration from the skin to

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the outer surface and then quickly dispersing it. Evaluation of water permeability becomes one of the most important requirements for research and development of sportswear,(4).

Currently, regenerated bamboo fibers have high demands in market and are being used in apparels including underwear, T-shirt, sports textiles, socks, towels, bathing suits, sanitary napkins, absorbing pads, bandages and surgical gowns,(5). Cotton fabric is highly popular to society because of its excellent properties such as regeneration, bio-degradation, softness, affinity to skin, and sweat-absorbing properties. Bamboo is extremely absorbent, it is about sixty percentage more water absorbent than cotton. Bamboo fiber is frequently being used in blends with cotton in textile industry which has got high wet strength. Blending is usually done using 50/50 combinations, (6).

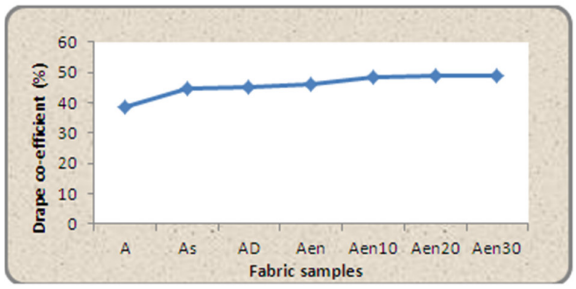
Material and Methods

Based on the literature survey results, 50:50 bamboo/cotton, 30'S count yarns were procured and using circular knitting machinesingle jersey knitted fabrics were developed. Then, the developed material were bio-scoured before Natural dyeing using *Bixa orella* (Annattoo seed) extract at 6% concentration with 3% *Puniga granatum* (Pomegranate rind). Microcapsules were developed for the herbal extracts namely 6% *Eucalyptus citriodora (*Eucalyptus leaf) for UV property and 6% *Azadirachtra indica (*Neem) for antibacterial property at 2:1 ratio, and applied on the fabrics using exhaust method. After finishing, the fabrics undergone thirty wash cycles. Then, the comfort properties of the finished fabrics were evaluated using drape co-efficient, air permeability, porosity, liquid moisture management property and water vapour resistance.

Drape Co-Efficient

According to BS 5058 test method, assessment of drape co-efficient was carried out for the unfinished and finished fabric before and after 10,20 and 30 washes. The results are given in figure 1.

Figure 1 Drape co-efficient

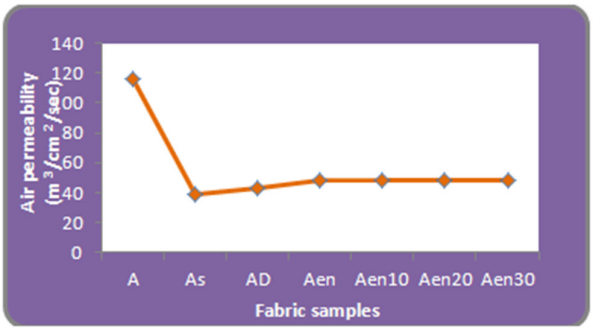


The drape co-efficient of A, As, AD, Aen, Aen10, Aen20 and Aen30 samples, were 38.84, 44.74, 45.18, 45.96, 48.44, 48.74, 48.84 respectively.

Air Permeability

According to ASTM D 737-04 test method, air permeability test was carried out using fabric air permeability tester. Each twenty samples were assessed and the mean value was calculated.The results are given in figure 2.

Figure2 Air permeability



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The air permeability of the samples A, As, AD, Aen, Aen10, Aen20 and Aen30 were 116, 39.08, 43, 48, 48, 48.2 and 48.2 respectively. From the statistical analysis, it was evident that there was significant difference between the samples with respect to air permeability at 1 % level.

Porosity

Using Capillary flow porometry (CFP-1200-A, PMI, New York, NY, USA), fully automated equipment, the porosity of the unfinished and finished fabrics were assessed. This test was repeated 20 times for each fabric and the mean value was calculated. The results are given in table 1.

Table 1 Porosity

S.No.	Fabric Samples	Pore size(microns)			
		Mean flow pore diameter	% loss or gain	Bubble point diameter	%loss or gain
1	Unfinished	13.4565	-	51.0685	-
2	Finished	17.0476	26	57.5274	12

From the above table 1, it was concluded that the mean flow pore diameter of the finished sample was increased up to 26%, when compared to unfinished sample. The bubble point diameter of the finished sample was increased to 12% when compared to unfinished. Hence, it could be concluded that during finishing it makes the pore size bigger than unfinished fabric.

Liquid Moisture Management Properties

According to AATCC 195 standard, the LMMP (Liquid Moisture Management Properties) of the fabrics were tested using Moisture management tester. The summary of the measured results are used to grade the liquid moisture management properties of the fabrics. This test was repeated 20 times for each fabric and the mean value was calculated and the results are given in table 2. For simple interpretation the results were converted into grade. The grades range from 1 to 5 means poor to excellent.

Table 2 Liquid moisture management property

S.No.	Fabric samples	Liquid moisture management property									
		WTt	WTb	Art	ARb	MWRt	MWRb	SSt	SSb	AOTI	OMMC
1	Unfinished	1.0	2.0	1.0	3.0	1.0	1.0	1.0	1.0	3.0	2.5
2	Finished	3.0	3.0	4.0	4.0	3.0	3.0	1.0	2.0	5.0	2.5

WTt - wetting time top, **WTb -** wetting time bottom, **Art -** absorbency rate top, **ARb-**absorbency rate bottom, **MWRt-** maximum wetting rate top, **MWRb -**maximum wetting rate bottom, **SSt-**spreading speed top, **SSb-**spreading speed bottom, **AOTI-** accumulative one-way transport capability.

OMMC- overall moisture management condition

From the above table 2, it was concluded that both unfinished and finished fabrics have good liquid moisture management capacity of grade 2.5. **One way transfer capacity** is excellent (grade 5) in unfinished fabric and good (grade 3) in finished fabric.

Unfinished fabric has very poor **spreading speed at top and bottom surface** (grade 1). Both top and bottom surface not showing wetting radius. Absorption rate of the finished sample is very good at the top and bottom (grade 4). Wetting Time for top and bottom surface is good in finished fabrics.

Finished fabric has good **wetting time and wetting radius both at top and bottom.** Absorption rate is very good both at top and bottom. Spreading speed is poor and fair in the top and bottom respectively. **AOTI** is good for finished fabric. Hence, over all moisture management capacity is between good and very good.

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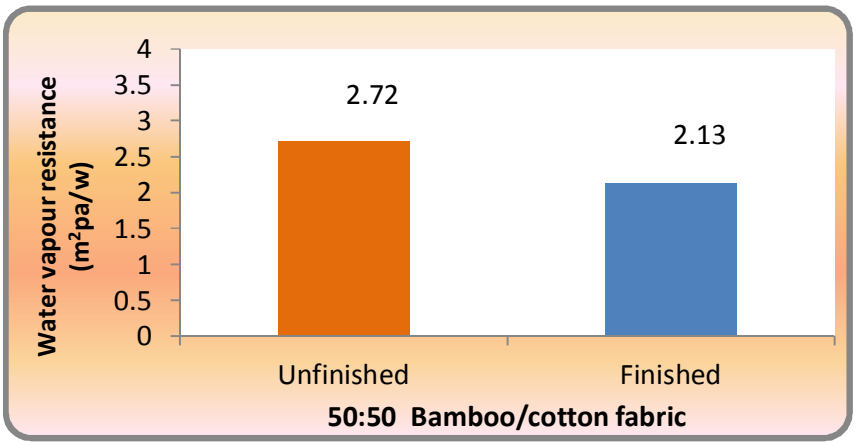
Water Vapour Resistance

According to ASTM (E 96-95), the Water vapour resistance of the unfinished and finished fabric were tested using Sweat Guarded Hot-Plate, according to ISO 11092 international standard test method. This test was repeated 20 times for each fabric. The results are given in figure 3.

Figure 3 Water vapour resistance



From the above figure 3, it was concluded that finished fabric (2.13) has less water vapour resistance compared to unfinished fabrics (2.72).

Conclusion

Comfort properties of the Natural dyed (Annattoo seed), 50:50 bamboo/cotton single jersey knitted fabric, finished with herbal extracts such as (*Eucalyptuscitriodora* (Eucalyptus leaf) and *Azadirachta indica* (Neem) were prepared at 2:1 ratio has been assessed. Regarding comfort properties of the finished fabrics, the sample Aen30 shows increased drape co-efficient 48.84%, compared to sample A (38.84). Regarding air-permeability, compared to sample A, other samples shows increased air-permeability that is for A and Aen30, the air permeability was 116 and 48.4 respectively. Porosity of the unfinished and finished samples were evaluated, from the result it could be concluded that the pore size of the unfinished sample (13.4565) increases in finished sample (17.0476). Both unfinished and finished fabrics have good liquid moisture management capacity of grade 2.5. From the result it was concluded that finished fabrics have (2.13) less water vapour resistance compared to unfinished fabrics (2.72).

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