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Effect of blend ratio on moisture management characteristics of regenerated bamboo/lotus single jersey knitted fabrics

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The moisture management properties of the pique knitted fabrics produced from lotus fibre fabrics have been evaluated by SDL- ATLAS moisture management tester and correlated with regenerated bamboo pique knitted fabrics. It is observed that the lotus fabric shows absorption rate similar to that of regenerated bamboo fabric, whereas bamboo lotus blended fabric shows improved spreading speed and one way transport capability than the other fabrics. The lotus fabric exhibits high dimensional stability and the high resistance to pilling. It shows that lotus fabrics are suitable for clothing applications.

Keywords: Blend ratio, Knitted fabrics, Lotus fibre, Moisture management properties, Pique fabric, Regenerated bamboo, Single jersey fabric

Now a day, fibres produced from natural source have gained attraction due to health and environmental concern shown by the people. Lotus is abundantly available and its flower is utilised for medicinal purposes. The binomial name of lotus is *Nelumbo nucifera*, also known as Indian lotus. The stem of the lotus plant is left as waste. The lotus fibre can be extracted manually from the stem of the lotus plant[1]. The lotus fibre can be used as textile raw material after the processing, which is low in fineness, with required strength and spin ability[2-3]. Many researchers[4-8] have studied the lotus fibre physical structural properties and feasibility of the converting it into fabric for various applications.

Lotus fibre is rich in cellulose content and shows excellent result. Hence, it is now being widely used as one of the textile materials. Generally, to utilize the properties of more fibre in a fabric, blending is done. Blending at fibre stage provides all desirable clothing properties, such as strength, drape, etc along with comfort properties at low cost and better quality[9-11]. The lotus fibre properties along with other fibre properties can also be used to prepare blended fabric for specific end uses.

Moisture management plays a major role in deciding the comfort of the clothing material. It is gaining importance and considered as one of the major criteria in new product development. Moisture management can be defined as the precise transfer of water vapour and perspiration from the human skin to the outer environment through the fabric. This action avoids the perspiration left over the skin for a longer time and thus body metabolism cools down more efficiently. It results in less perspiration, less tiredness and less discomfort. Hence, the role of textile fabric is transporting. Moisture is key factor and depends on fibre type, yarn type, fabric type, finishes, etc. Hence, the transmission of moisture through clothing material has been acknowledged as significant mechanism, while designing garments for sports, medical, technical applications. Several studies are being carried out in this area[12,13].

The study on moisture management of the fabric is focused on capability of dynamic liquid transfer of the fabric from the inner surface to the outer surface quantitatively[14-15]. The perspired sweat has to be transferred immediately, else humidity of the microclimate will rise, thereby generating excess sweat[16]. The effect of cross- section and diameter of the fibre plays a major role in the transport of moisture[17]. The type of fibre and the stitch length of the knitted fabric also influence the moisture management properties of the fabric[18]. Thus, appropriate choice of fabric is important in providing comfort feel to the wearer. This study aims to investigate the moisture management characteristics of regenerated bamboo/lotus knitted fabrics.

Experimental

Lotus fibre extracted manually and regenerated bamboo fibres were used in the production of knitted fabric samples. The 100% regenerated bamboo, 100% lotus and 50:50 regenerated bamboo: lotus yarn production were carried out by Lotus Champs Agro

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Unit, Thane for this analysis. The fibres were sourced from a single lot and then spun as required for the study. The technical details of both bamboo and lotus are given in Table 1. The yarn and fabric properties of bomboo, lotus and their blends are given in Table 2.

The produced yarns were used to produce pique structured knitted fabrics on Rel-Tex single jersey pique fabric knitting machine (YFSG model) with 24G gauge, 30" diameter, 26 feeders and 1200 needles. The technical particulars of the fabric produced, its dimensional stability and pilling resistance are given in Table 2. The produced fabric samples were scoured, rinsed and washed. The samples were dried and conditioned in relaxed state under standard atmospheric conditions of 30 ± 2°C temperature and 65± 2% relative humidity for 24 hours and taken for the study. The Moisture Management Tester (MMT) from SDL Atlas Ltd., Hongkong was used to test the moisture management qualities of the knitted materials. The MMT featured upper and lower concentric moisture sensors, surrounding the knitted sample. A collection of indexes is calculated based on the signal obtained, the descriptions of which are presented by Hu *et al*[19]. The indices are assessed and transformed from value to grade using a five-grade scale, according to AATCC Test Method 195–2009.

Table 1 — Technical properties of bamboo and lotus fibre

Property	Regenerated bamboo fibre	Lotus fibre
Mean length, mm	36	38
Fibre fineness, dtex	1.52	1.09
Linear density	0.155tex	25.9 dtex
Moisture regain, %	11.42	12.32
Tenacity, g/tex	22.84	34.35
Elongation, %	21.2	14.07

Table 2 — Technical properties of bamboo and lotus yarn, fabric and their blends

Property	Bamboo:lotus		
	100:0	50:50	0:100
	Yarn		
Linear density, tex	14.76	14.56	14.32
Diameter, mm	0.211	0.19	0.17
Unevenness, %	9.04	8.51	5.23
Thick /km (+50%)	11	9	2
Thin /km (-50%)	5	3	3
Hairiness, 3mm/km	627	798	511
Neps/km	21	14	4
Tenacity, cN/tex	16.01	14.08	12.44
Elongation, %	9.88	9.01	8.48
	Fabric		
Structure	Pique	Pique	Pique
CPI	30	34	36
WPI	22	24	28
Thickness, mm	0.75	0.74	0.71
Stitch length, mm	3	2.95	2.98
Weight, g/m^2	117	115	123
Dimensional stability, %	Width-6.5 Length+3.5	Width-1 Length-1	Width-1.7 Length-1
Martindale pilling resistance			
After 125 rubs	3-4	4	4-5
After 500 rubs	3	3-4	4-5
After 1000 rubs	2-3	3	4-5
After 2000 rubs	2	3	4

Results and Discussion

Physical Properties of Yarn

Regenerated bamboo fibre is known for its unique properties whereas lotus fibre exhibits lesser diameter than the regenerated bamboo fibre, which is due to the fibre fineness. Also the extracted lotus fibre from lotus stem shows more evenness with lesser thick places, thin places and neps. On the other hand, lotus fibre shows lesser tenacity and elongation percentage as compared to regenerated bamboo and its blended yarn.

Physical Properties of Fabric

It may be clearly observed from the Table 1 that the pique knitted fabric with the similar linear density and stitch length shows lesser thickness of the fabric with the increase in lotus fibre content, whereas the weight of the fabric shows reverse trend. This is mainly because of the lesser diameter of the lotus yarn than regenerated bamboo yarn and its blends. The weight of lotus fabric is higher than other fabrics and it is because of higher CPI and WPI.

Moisture Management Properties

The moisture management properties, such as wetting time, absorption rate, maximum wetted radius, water spreading speed and one way transport capabilities, of regenerated bamboo and lotus fabric samples, valuated by SDL- ATLAS moisture management tester, are discussed hereunder.

The time taken for wetting (wetting time) on the top and bottom surfaces of the regenerated bamboo lotus fabrics are presented in Fig. 1. The surface which is in contact with skin and involved in transferring the perspiration is referred as top surface, the whole surface which is exposed to the outer environment is referred as bottom surface. The wetting time of the regenerated bamboo, lotus and

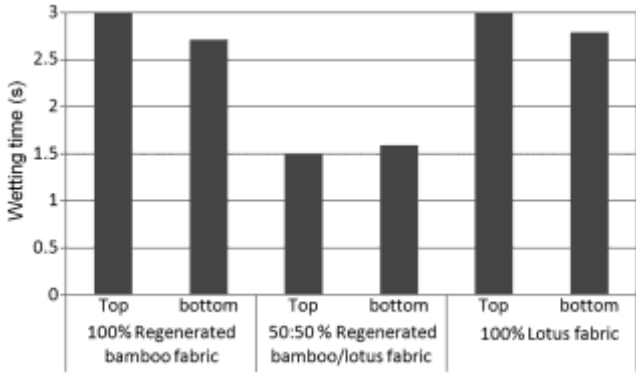

Fig. 1 — Wetting time of regenerated bamboo/lotus knitted fabrics

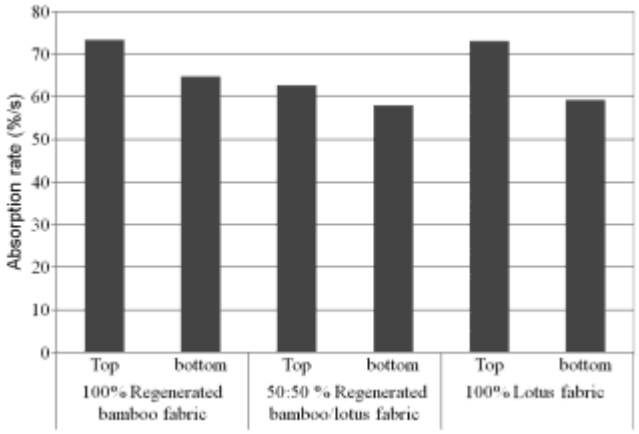

Fig. 2 — Absorption rate of regenerated bamboo/lotus knitted fabrics

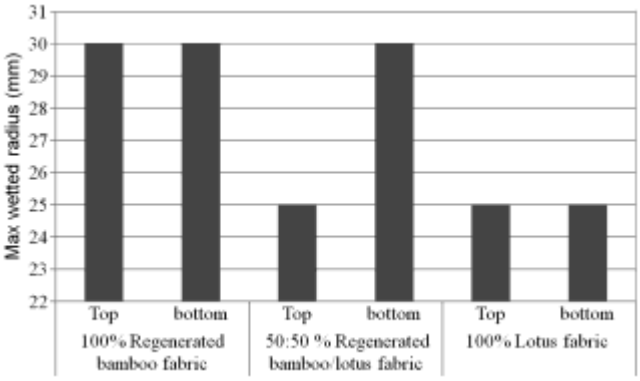

Fig. 3 — Maximum wetted radius regenerated bamboo/lotus knitted fabrics

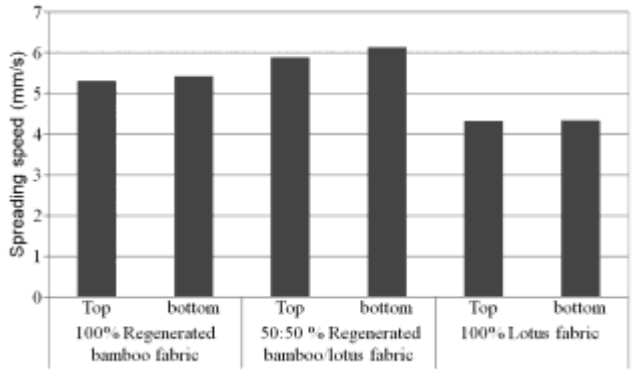

Fig. 4 — Spreading speed of regenerated bamboo/lotus knitted fabrics

blended fabric differs. The wetting time on the top surface of the regenerated bamboo and lotus fibre is found similar. An interesting fact is that the blended fabric shows quicker wetting time than other two samples. This result emphasizes that the moisture wetting is better with the regenerated bamboo lotus blended fabric.

The absorption rate of the produced fabrics is presented in Fig. 2. Similar to the wetting time, the absorption rate of the bottom surface is lower than the top surface and this is mainly because of the time taken for the liquid to travel through the thickness of the fabric from top to bottom surface. Even though the thickness of the lotus fabric is lesser than other two fabrics, it exhibits absorption rate similar to regenerated bamboo fabric. Comparatively lesser quantity of air, entrapped in the less thick fabric, is immediately replaced with liquid and assists in faster absorption of liquid. In the case of regenerated bamboo/lotus blended fabric, though it shows quicker wetting time, its absorption rate is lower by 9% and 4% in top and bottom surface respectively as compared to regenerated bamboo fabric. This is due to tighter fabric with lower porosity.

The results of maximum wetted radius of all the three fabrics produced are given in Fig. 3. The maximum wetted radius of regenerated bamboo fabric is higher on both the surfaces. The 100% lotus fabric shows minimum wetting area in the given time and attains saturation point at very early stage of wetting process. When comparing the result of the regenerated bamboo/ lotus fabric with other two fabrics, it is interesting to note that the radius of wetted area on the bottom surface is superior to top surface. It indicates the excellent moisture transport property of the blended fabric, which will provide comfort feel to the wearer.

The results of liquid spreading speed of the fabrics are given in Fig. 4. The spreading speed of the regenerated bamboo/lotus blended fabric is rated superior than those of other two fabrics. It falls in line with the results of wetting time and maximum wetted radius of the blended fabric. It can be clearly seen that the combination of regenerated bamboo and lotus shows higher spreading speed. Similarly, the

spreading speed on the bottom surface is superior to top surface of the blended fabric, which will provide comfort feel to the wearer.

The result of one way transport capability of the 100% regenerated bamboo fabric is 108.9575, 100% lotus fabric is 123.7267 and regenerated bamboo lotus blended fabric is 42.4346. It is the measure of change in the accumulated liquid content on both the surfaces of the fabric, which indirectly indicates the capability of transporting liquid from inner to the outer surface. From the result obtained, the blended fabric shows lesser difference and it confirms the results obtained for the wetting time, absorption rate, maximum wetted radius and liquid spreading speed.

The 100% regenerated bamboo pique knitted fabric possesses good moisture management property when compared to the lotus pique knitted fabric. The effect of blend shows remarkable moisture management results, where the blended fabric provides quicker wetting time, highest absorption rate, maximum wetted radius on bottom surface with higher wetting radius. According to the results, it can be stated that, as the lotus content increases, overall moisture management capability of the fabrics increases. It is concluded that the regenerated bamboo/lotus blended fabrics have excellent moisture management property and faster liquid transporting capability, which is very essential for clothing material.

References

1 Rao K M M & Rao KM, *Compos Struct*, 77 (2007) 288.
2 Bera A, Ghosh A, Mukhopadhyay A, Chattopadhyay D & Chakrabarti, K, *Bioproc Biosyst Eng*, 38 (2015) 341.
3 Fan P, He F, Yang Y, Ao M Z, Ouyang J, Liu Y & Yu L J, *Biochem Eng J*, 97 (2015) 50.
4 Geethanjali T, Prakash C, Rajwin AJ & Kumar M R, *Fibre Text East Eur*, 29 (2021) 36.
5 Jebastin Rajwin A & Prakash C, *Indian J Fibre Text Res*, 45 (2020) 395.
6 Sampath M B, Prakash C & Senthil Kumar M, *Indian J Fibre Text Res*, 45 (2020) 102.
7 Prakash C & Karunakaran KC, *Indian J Fibre Text Res*, 44 (2019) 294.
8 Karunakaran KC & Prakash C, *Fibre Text East Eur*, 25 (2017) 53.
9 Prakash C & Ramakrishnan G, *J Text Inst*, 104 (2013) 907.
10 Prakash C & Ramakrishnan G, *Int J Thermophy*, 34 (2013) 113.
11 Priyalatha S & Raja D, *J Text Inst*, (2016). doi:10.1080/00405000.2016.1220232.
12 Chidambaram P & Govindan R, *Sci Eng Health Stud*, 6 (2012) 49.
13 Raja D, Priyalatha S & Senthil kumar M, *Indian J Fibre Text Res*, 44 (2019) 173.
14 Yao BG, Li Y, Hu JY, Kwok Y L & Yeung KW, *Polym Test*, 25 (2006) 677.
15 Hu J, Li Y, Yeung KW, Wong AS & Xu W, *Text Res J*, 75 (2005) 57.
16 Haghi A K & Ghanadzadeh H, *Indian J Fibre Text Res*, 12 (2005) 654.
17 Das BR, Bhattacharjee D, Kumar K & Srivastava A, *Res J Text Appar*, 17 (2013) 133.
18 Duru S C & Candan C, *Text Res J*, 83 (2013) 591.
19 Hu J, Li Y, Yeung K, Wong ASW & Xu W, *Text Res J*, 75 (2005) 57.