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RESEARCH ARTICLE

PRODUCTION OF BAMBOO/COTTON AND BAMBOO/POLYESTER BLENDED RING SPUN YARNS AND ASSESSMENT OF THE QUALITY CHARACTERISTICS USING THE SELF DEVICED FRICTION TESTING INSTRUMENT

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ABSTRACT

This paper describes the measurement of friction based on inclined plane method. The main principle of this instrument is that the yarn for which the coefficient of friction has to be estimated forms the inclined plane itself. The angle of inclination of the yarn can be easily varied by using suitable weights. It can be concluded from the study that more weights used in experiment reduces the frictional values of the yarn.

INTRODUCTION

Blending of different fibres is a very common practice in the spinning industries. The blending is primarily done to enhance the properties of resultant fibre mix and to optimize the cost of the raw material. The properties of blended yarns primarily depend on the properties of constituent fibres and their compability. Moreover, the proportion of fibres in the blend also plays a significant role. It has been observed that the stronger component has to be mixed at least by a certain proportion in order to gain in terms of tensile properties[1].However many times reduction of cost of natural fibres is considered important. The sort of material for blending is also very important because not all materials can be mixed together. Wrong combinations can result in shrinkage or very weak structure of fabric. So, it becomes essential for the researcher to design and introduce novel and vibrant yarns to the market to satisfy the consumers with various tastes and variety of end applications [2]. In the cotton spinning process, blending has the objective of producing yarn with acceptable quality and reasonable cost. A good quality blend requires the use of adequate machines, objective techniques to select bales and knowledge of its characteristics. Knowledge of the importance of blended products in the textile industry and the generally rising costs of production make the achievement of economic and good quality blends with different kinds of cotton more and more critical. Bamboo and bamboo-cotton blended yarns are a key part of the 'natural product ' theme and are recommended for use in 'soft look/soft feel' textiles, like towels, knits and socks, as well as in home-textiles sourced by leading global MNC brands. Yarns of bamboo fibre provide the desirable properties of high absorbency, antimicrobicity and soft feel in textiles and made-ups[3] Friction is the tangential force to the surface when a body resisting motion slides over another surface. The two basic laws of friction that the frictional resistance is proportional to the load and that it is independent of the area of the sliding surfaces have been known for a long time[4]. Friction is very important characteristic of textile materials. Through the friction fibres are connected into yarns and the yarns into fabric or knitting. Some of the characteristics of textile products, such as touch and felt properties, softness etc., depend on friction. Interaction between the yarns, based on friction, determines different mechanical properties of the woven and tricot fabrics, such as: traction, compression, twisting and shear characteristics. The friction is directly influencing productivity and quality of textile production. This is very important reason for the investigation of friction properties[5]

The present study was conducted to find out the impact of the bamboo/cotton and bamboo/polyester blend ratio on the quality characteristics of yarn and also to optimize the blending ratio that produced excellent quality yarn were selected with the following objectives. To produce twenty six different blend proportions of Bamboo/Cotton and Bamboo/ Polyester with two different levels of twist factors. Development of yarn testing instrument in relation to friction.

METHODOLOGY

The methodology of the study consists of the following aspects.The experimental part of the present study investigating the influence of the bamboo content in bamboo/cotton and bamboo/polyester blends at the different stages of spinning fibre to make yarn was carried out.

Selection of fibre

Five kgs Cotton samples of Sankar-6 were selected with the following parameters tested such as fibre length 28.4 mm, strength 22.5g/tex, elongation 5.3%, fineness (micronaire) 3.7 μ g/ in. Ten kgs bamboo

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fibre were selected with the following parameters such as fibre diameter 0.01323 mm, fibre length 38mm, strength 2.54g/den, elongation 19.2%, denier-1.2. Five kgs polyester fibre were selected with the following parameters such as fibre diameter .00971mm, fibre length 40mm, strength 6.41g/den, elongation 17.5%,denier-1. The process steps of fibre blending, lap production, carding, drawing, rove-preparation and spinning were controlled to result in 19.68 tex. The following table-1 illustrates the blend ratio of blended manufactured yarn.

Table-1. Blend ratios of Bamboo, Cotton and Polyester with two different twist factors (3.4 & 4)

100% bamboo	100%cotton
80% bamboo	80%cotton
20% polyester	20%bamboo
67% bamboo	67%cotton
33% polyester	33%bamboo
50%bamboo	50%cotton
50%polyester	50%bamboo
33% bamboo	33%cotton
67% polyester	67%bamboo
20%bamboo	20%cotton
80% polyester	80% bamboo
100%polyester	_nil_

Selection of spinning process

Ring spinning machine is universally applicable to any material can be spun to any required fineness. It delivers yarn with optimal characteristics. Ring spinning is still accepted as the most important method in short staple spinning and in spite of the new spinning methods which come on the scene with the purpose to increase the production, ring spinning is still in the first category owing to its continous development[6]. The process steps of fiber blending, lap production, carding, drawing, rove-preparation and spinning were controlled to result in 19.68 tex. The following process were followed for ring spinning process to produce yarn from selected fibre and blends. There are five stages in spinning. They are :

1. Lap to card sliver by the carding process.
2. Card sliver to doubling is drawing process.
3. Drawing Sliver to roving is called simplex process.
4. Roving sliver to yarn by further drafting and twisting process is ring spinning process.
5. Yarn reeled on bobbins, spools, or cones by the winding process.

Development of yarn testing instruments- Friction

The friction tester was the instrument developed by the investigator to find out the accurate value of the produced yarns (Plate-1).

Objective : To find the frictional values of different thread samples using different weights using inclined plane method by friction tester.

Procedure

First place the friction meter on a surface. Then tie the yarn along the 16mm adjustable screw present on the steel plate and run it over the pulley by initial weight (2.14g, 3.33g, 4.80g, 9.84g & 14.15g) and make sure the yarn measures 90 degrees perfectly parallel to the steel plate (50mm x 5mm thickness).

μ is angle measured by the yarn over the pulley.

$\mu = \tan\theta$ = gives the friction of the particular sample.

The average of 10 readings $\mu = \tan\theta$ gives the accurate friction of a particular yarn sample. Take a yarn sample and tie its one end to the adjustable screw present on the steel plate and hang a weight to the other end over the pulley. Now perform the initial check as stated above. After checking the yarn to be parallel to the steel plate. Place a small wire (traveler mass) in the middle that will be able to slip along the thread sample making sure that thread sample does not snap or sag. Rotate the bolt nut (16mm) until the wire on the yarn sample start to slip. Exactly note the position from where started to slip. Now stop rotating and measure the angle which the yarn sample makes along the protactor attached to the vertical steel plate. Note the angle which is μ. Calculate $\mu = \tan\theta$ which is friction. Now repeat the above experiment for the same yarn sample and same weight for ten times and calculate the average of $\mu = \tan\theta$ which gives the exact friction of the particular yarn sample. Then keeping the same yarn sample , calculate the friction using different weights following the procedure mentioned above.

So we have calculated frictional values of the yarn by using different weights. Hence we infer that the frictional value of the yarn varies for different weights. Now repeat the whole experiment stated above for different yarn samples and calculate the frictional value which again varies for each different weights. All the produced yarns was evaluated using the above instrument and procedure followed to the get the flexural rigidity of the yarns.

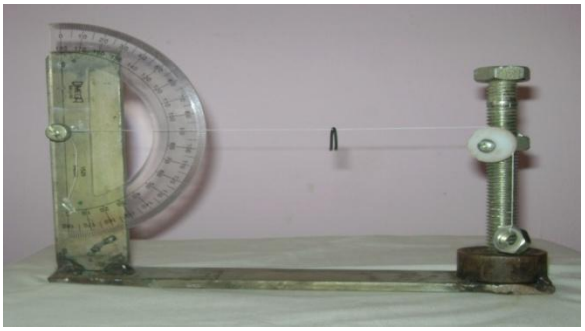

Plate- 1 Friction tester

RESULTS AND DISCUSSION

The results of the various tests were analyzed statistically by one way ANOVA. The difference between the samples and within the samples was found. The t test was applied to find the difference between the two samples (in this case between two twists 3.4 & 4.0). DMRT (Duncan Multiple Range Test) is applied to find out significant difference amongst (26 samples) by ranking the series[6]. From the table 2, it can be concluded that the friction, when statistical analysis using anova to compare the above tests values, it is evident that as P value is less than 0.001, there is significant difference amongst all samples for all the tests in both the twists between 3.4 and 4.0. Please note that sample with one series indicates 3.4 twist and sample with two series indicates 4.0 twist. The sample E1 - 33% Bamboo 67% Polyester, E2 – 33% Bamboo 67% Polyester for tension levels of 2.14grams, 9.84grams, 14.15grams respectively showed higher increase in friction value, Similarly J1 – 67% Cotton 33% Bamboo, J2 – 67% Cotton 33% Bamboo for tension levels of 9.84g and 14.15g showed increase in friction value. In relation to twist, the sample J1 – 67% Cotton 33% Bamboo, J2 – 67% Cotton 33% Bamboo showed significant difference. As the weight increases, friction value decreases.

The sample A1(100%Bamboo),A2(100%Bamboo) and G1(100% Cotton),G2(100% Cotton) is compared with B1(80% Bamboo/20% Polyester),B2(80%Bamboo/20% Polyester),C1(67% Bamboo/33% Polyester),C2(67%Bamboo/33%Polyester),D1(50%Bamboo/50%Polyester),D2(50%Bamboo/50%Polyester),E1(33%Bamboo/67%Polyester), 2(33%Bamboo/67%Polyester),F1(20%Bamboo/80%Polyester),F2(20% Bamboo/80% Polyester) and sample A1,A2 and H1(100% Cotton), H2(100% Cotton) is compared with I1(80% Cotton /20% Bamboo), I2(80% Cotton/ 20%Bamboo), J1(67%Cotton/33% Bamboo), J2(67% Cotton/33% Bamboo), K1(50% Cotton/50% Bamboo), K2(50% Cotton/50% Bamboo), L1(33% Cotton/67% Bamboo), L2(33% Cotton/67%Bamboo), M1(20% Cotton/80% Bamboo) and M2 (20%

Table 2. The friction between the two twists (3.4 and 4.0) at all tension levels (2.14g, 3.33g, 4.80g, 9.84g and 14.15g) for 26 samples. From statistical analysis using anova to compare the tension levels , it is evident that as P value is less than 0.001,there is significant difference between the tension levels in both the twists between 3.4 and 4.0.

Sample		Tension				
		2.14g	3.33g	4.80g	9.84g	14.15g
100% BAMBOO	Mean	0.235	0.159	0.119	0.106	0.097
	SD	(0.047)	(0.026)	(0.023)	(0.027)	(0.022)
80% BAMBOO / 20% POLY	Mean	0.230	0.186	0.160	0.139	0.117
	SD	(0.041)	(0.048)	(0.033)	(0.037)	(0.033)
67% BAMBOO / 33% POLY	Mean	0.262	0.208	0.195	0.186	0.127
	SD	(0.047)	(0.044)	(0.041)	(0.052)	(0.028)
50%BAMBOO/50%POLY	Mean	0.259	0.215	0.171	0.144	0.097
	SD	(0.027)	(0.033)	(0.039)	(0.037)	(0.013)
33%BAM/67%POLY	Mean	0.272	0.214	0.209	0.197	0.145
	SD	(0.046)	(0.023)	(0.028)	(0.026)	(0.018)
20%BAMBOO/80%POLY	Mean	0.250	0.231	0.214	0.194	0.123
	SD	(0.041)	(0.015)	(0.018)	(0.020)	(0.017)
100%POLYESTER	Mean	0.252	0.229	0.174	0.154	0.120
	SD	(0.033)	(0.032)	(0.014)	(0.019)	(0.013)
100%COTTON	Mean	0.202	0.185	0.181	0.152	0.142
	SD	(0.017)	(0.020)	(0.013)	(0.017)	(0.023)
80%COTTON/20%BAMBOO	Mean	0.256	0.215	0.195	0.168	0.125
	SD	(0.015)	(0.010)	(0.017)	(0.015)	(0.013)
67%COTTON/33%BAMBOO	Mean	0.251	0.211	0.167	0.123	0.101
	SD	(0.020)	(0.017)	(0.024)	(0.012)	(0.009)
50%COTTON/50%BAMBOO	Mean	0.249	0.196	0.174	0.143	0.109
	SD	(0.019)	(0.016)	(0.035)	(0.012)	(0.009)
33%COTTON/67%BAMBOO	Mean	0.246	0.198	0.183	0.138	0.106
	SD	(0.022)	(0.013)	(0.015)	(0.010)	(0.011)
20%COTTON/80%BAMBOO	Mean	0.251	0.200	0.175	0.139	0.113
	SD	(0.020)	(0.015)	(0.011)	(0.009)	(0.012)
F value		5.648	10.799	17.462	22.458	14.213
P value		<0,001**	<0,001**	<0,001**	<0,001**	<0,001**

Note: 1. ** denotes significance at 1% level.

Cotton/80% Bamboo) to study the effect of blend composition on friction. When A1, A2 and G1,G2 is compared with its blend compositions, based on DMRT sample E1, E2 excelled in terms of tension of 2.14g,9.84g and 14.15g with mean value of 0.272 ,0.197 and 0.145 followed by second order of significance sample F1,F2 in terms of tension of 3.33g,4.80g and 9.84g with mean value of 0.231,0.214 and 0.914 which is followed by third order of significance sample C1,C2 in terms of tension of 9.84g,14.15g with mean value of 0.186 and 0.127 which is followed by fourth order of significance sample D1,D2 in terms of tension 9.84g,14.15g with mean value of 0.144 and 0.097 which is followed by fifth order of significance sample B1,B2 in terms of tension of 3.33g,4.80g with mean value of 0.230,0.186 and 0.160 When A1,A2 and H1,H2 is compared with its blend compositions, based on DMRT sample J1,J2 follows first order of significance in terms of tension of 9.84g and 14.15g with mean value of 0.123 ,0.101 followed by second order of significance sample K1,K2,M1and M2 in terms of tension of 9.84g with mean value of 0.143 and 0.139 respectively.

Conclusion

The sample E1 - 33% Bamboo 67% Polyester, E2 – 33% Bamboo 67% Polyester for tension levels of 2.14grams, 9.84grams, 14.15grams respectively showed higher increase in friction value, Similarly J1 – 67% Cotton 33% Bamboo, J2 – 67% Cotton 33% Bamboo for tension levels of 9.84g and 14.15g showed increase in friction value. In relation to twist, the sample J1 – 67% Cotton 33% Bamboo, J2 – 67% Cotton 33% Bamboo showed significant difference. As the weight increases, friction value decreases

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