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Comparison of polyester-cotton blended yarns produced by blending of polyester with semi-combed and super-carded cotton fibres

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Polyester-cotton blended yarns have been produced with the combination of two different types of blending, viz. blowroom and drawframe and two different methods of removing short fibres, viz. semi-combing and super-carding as the later method is economical. It is found that the yarns produced using blowroom blending method show better yarn quality as compared to that of drawframe blending with respect to evenness, imperfections, classified faults and tensile strength. Compared to the yarn produced using polyester-semi combed cotton and drawframe blending, the yarn produced using polyester-super carded cotton and blowroom blending gives better quality yarn.

Keywords: Blowroom blending, Polyester-cotton blend, Drawframe blending, Semi-combed fibre, Super-carded fibre

1 Introduction

Blending of fibres with different characteristics has assumed importance with the introduction of a wide range of man-made fibres and it is possible to produce fabrics covering a wide range of characteristics with the judicious blending of two or more different types of fibres. Blending can be done mainly by two methods, viz. (i) blowroom and (ii) drawframe. Both methods have their own advantages and disadvantages. The intimacy in blending is excellent with blowroom blending rather than that of drawframe blending but the number of processes involved in achieving this is cumbersome. In the blowroom blending, fractionalization of fibres changes the population of the individual fibres and this in-turn affects the blend proportion place to place[1]. The longitudinal blending is better and the traverse blending is poor in drawframe blending and vice-versa in blowroom blending[2]. Minimum of three drawframe passages are required to obtain quite a satisfactory blend[3]. The average strength of a yarn depends only on the proportions and properties of constituent fibres if the stress is uniformly distributed across the section of the yarn. However, variations in the composition of different sections of the yarn will lead to irregularity in yarn strength[4]. The degree of mixing and its relationship with the amount of doubling has been discussed by Lund[5,6]. Balasubramanian[7] studied the causes for thick faults and slubs and found that clusters of similar type of fibres that cause imperfections and streakiness in yarns can be avoided by carrying out the blending at the earliest stage possible. In polyester-viscose blended AJS yarn, within and between zone variance and index of blend irregularity values are minimum for polyester-viscose blowroom blended yarns and higher for drawframe blended yarns[8].

The yarn produced from blending of polyester with carded cotton has higher unevenness, thick places and thin places due to grouping of fibres during roller drafting because of higher length variability among the fibres. Hence, in practice, semi-combing (6-8% noil extraction) is carried out to remove very short fibres. It is found in practice that the fibres coming out of the detaching roller has clusters while semi-combing the cotton, which affects the quality of yarn. In the present work, it is tried to remove this additional 6-8% of short fibres at the carding machine itself (called super-carding). The super-carding of cotton is economical compared to semi-coming due to less number of processes involved. The yarns produced from blending of polyester with semi-combed cotton, and super-carded cotton have been compared. The effect of these two methods of short fibre removal, in combination with the two blending methods viz. blowroom blending and drawframe blending, on yarn quality has also been studied.

2 Materials and Methods

2.1 Preparation of Yarn Samples

Polyester-cotton blended yarn of 10.2 tex (58 Ne) was produced using four different methods, viz. (i)

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semi-combing of cotton and blending at drawframe, (ii) semi-combing of cotton and blending at blowroom, (iii) super-carding of cotton and blending at drawframe, and (iv) super-carding of cotton and blending at blowroom. The total waste removed at card and comber was maintained within the range of 17 - 18.2%. The yarn samples were prepared in a spinning mill (Sree Kaderi Ambal Mills, Tamilnadu, India) producing polyester cotton blended yarn. The details of the machinery are given as follows:

Blowroom : Crosrol
Card : MK5, Crosrol
Draw frame : DO2/S, Lakshmi Machine Works (LMW)
Sliver lap forming machine :E2/4a, LMW
Ribbon lap forming machine :E4/1a, LMW
Comber : E7/4, LMW
Speed frame : LF1400, LMW and
Ring frame : DJ/5, LMW.

The speed and settings at the card used for extracting around 5% waste from cotton for the samples 1 and 2 are given as follows: Licker in speed–800 rpm, cylinder speed–360 rpm, doffer speed–32 rpm, flat speed–10 cm/min and flats to cylinder settings–0.3/0.3/0.25/0.25 mm. For supercarding (extracting around 11% of waste) of cotton to prepare samples 3 and 4, following changes have been made in the card: licker in speed–900 rpm, doffer speed–22 rpm, flats speed–18 inch/min, and flats to cylinder setting–0.25/0.2/0.2/0.2 mm. The material properties and process parameters used for the production of yarn samples are given in Table 1. The sequence of

Table 1 — Materials and process parameters used for the production of yarn samples
[Polyester fibre: Denier 1.0 and cut length 40 mm; Cotton fibre: 2.5% span length 30 mm]

Parameter	Sample 1	Sample 2	Sample 3	Sample 4
Count, Ne	58	58	58	58
Blend (Nominal)	65/35 P/C	65/35 P/C	65/35 P/C	65/35 P/C
Type of blending	Drawframe blending	Blowroom blending	Drawframe blending	Blowroom blending
Type of short fibre removal	Semi-combing	Semi- combing	Super- carding	Super- carding
Process parameters (Waste removal at)				
Blowroom (cotton), %	4.5	4.5	5.5	5.5
Card (cotton), %	5.0	4.7	11.0	10.5
Blowroom and card (polyester/cotton), %	-	1.5	-	1.5
Comber noil, %	7.5	7.5	-	-
Total waste, %	17.0	18.2	17.0	17.5

Table 2 — Sequence of operations for producing yarn samples

Sample 1		Sample 2		Sample 3		Sample 4	
Cotton	Polyester	Cotton	Polyester	Cotton	Polyester	Cotton	Polyester
B/R	B/R	B/R		B/R	B/R	B/R	
Card	Card	Card		Card	Card	Card	
Lap prep.		Lap prep.		D/F -1	D/F -1	B/R	
Comber		Comber		D/F -2		Card	
D/F -1	D/F -1	B/R		D/F -3		D/F -1	
D/F -2		Card		D/F -4		D/F-2	
D/F -3		D/F -1					
D/F -4		D/F -2					

B/R – Blowroom, D/F – Draw frame.

operations used for the preparation of finisher sliver for feeding speed frame is given in Table 2.

2.2 Testing of Yarn Samples

The yarn samples were tested using a Premier IQ tester for unevenness % and imperfections. The imperfections were measured at all the sensitivity levels, viz. thin: –30%, –40%, –50%, –60%; thick: +35%, +50%, +70%, +100%; and neps: +140%, +200%, +280%, + 400%. The tests were carried out using the following specifications: test speed 400 m/min; test time 1 min; and No. of tests 40 per sample. The single yarn tensile properties were measured using Premier Tensomaxx tester with 500 mm gauge length, 5000 mm/min testing speed and 300 tests per sample. The yarn faults were measured using Premier Classidata tester with 330m/min test speed, 100 km test length and 3 tests/ sample. The blend proportion was determined as per standard BIS–SP (Part1):1989 (Source: IS 3416:1988). Significance tests were conducted for tensile strength, elongation-at-break and imperfections of yarn. Multiple comparisons between the samples have been carried out using Tukey's procedure at 5% significance level.

3 Results and Discussion

3.1 Unevenness and Imperfections

The unevenness % and imperfections measured at different sensitivity levels are given in Table 3. It can be seen from the Table 3 that the thick places are highest for Sample 3 and lowest for Sample 2. The number of thick places in the yarn has the following order: Sample 2 < Sample 4 < Sample 1 < Sample 3; for the thin places: Sample1&2 < Sample 4 < Sample 3; and for the neps: sample 2 < Sample 4 < Sample 1 < Sample 3. The difference in thick places and neps between the samples is statistically significant (Table 4) and in the case of thin places, the difference is statistically significant in most of the cases except between the Sample 1 and Sample 2. It is known that better individualisation of fibres by the card and subsequently by the combing process reduces the formation of thick and thin places during roller drafting. The thick and thin places are less for Sample 2 due to better individualisation of cotton fibres as they are processed twice by the card and once by the comber. In the case of Sample 4, the cotton fibres are opened twice by the card but not subjected to combing process. In the case of Sample 1, the cotton fibres are individualized once by the card and once subjected to combing process. The thick and thin places are higher for Sample 3 because the cotton fibres are subjected to carding process only once and hence individualization is less compared to all the other samples. Lower neps present in the Sample 2 is attributed to higher neps removal due to two time process at card and once at comber.

The quality of yarn with respect to unevenness as indicated by U% is in the order of Sample 2 < Sample 1&4 < Sample 3. The trend is found to be similar to that of thick and thin places. It is known that the unevenness is directly related to the thick and thin places present in the yarn.

Table 3 — Unevenness and imperfections of yarn samples

Property	Sample 1	Sample 2	Sample 3	Sample 4
U %	14.79	14.48	15.98	14.91
CV%	19.27	18.48	20.85	19.12
CV(1m)%	6.287	5.31	6.95	5.31
CV(3m)%	5.24	4.31	5.74	4.28
Index	1.77	1.69	1.91	1.75
Thin (-30%)	4862	4887	5704	5176
Thin (-40%)	1184	1217	1528	1332
Thin (-50%)	139	142	207	168
Thin (-60%)	8	6	12	9
Thick (+35%)	2332	2114	3041	2439
Thick (+50%)	867	588	1285	780
Thick (+70%)	285	105	434	172
Thick (+100%)	79	12	105	23
Neps (+140%)	3402	2856	4944	3691
Neps (+200%)	1313	745	1999	1118
Neps (+280%)	521	177	726	297
Neps (+400%)	178	41	202	63

Table 4 — Significance test between samples

Property	Sample 1&2	Sample 2&3	Sample 3&1	Sample 1&4	Sample 2&4	Sample 3&4
Um %	S	S	S	I	S	S
CVm%	S	S	S	I	S	S
Thin (-30%)	I	S	S	S	S	S
Thin (-40%)	I	S	S	S	S	S
Thin (-50%)	I	S	S	S	S	S
Thin (-60%)	I	S	S	I	I	S
Thick (+35%)	S	S	S	I	S	S
Thick (+50%)	S	S	S	S	S	S
Thick (+70%)	S	S	S	S	S	S
Thick (+100%)	S	S	S	S	S	S
Neps (+140%)	S	S	S	S	S	S
Neps (+200%)	S	S	S	S	S	S
Neps (+280%)	S	S	S	S	S	S
Neps (+400%)	S	S	S	S	S	S
Tensile strength	S	S	I	S	S	S
Elongation-at-break	I	I	I	I	S	I

S— Statistically significant, I— Statistically insignificant.

Table 5 — Classimat faults of yarn samples

Parameter	Sample 1	Sample 2	Sample 3	Sample 4
A4	39	15	47	10
B4	47	11	35	14
C4	24	8	26	13
D4	4	1	2	1
A3	275	60	235	59
B3	123	21	92	39
C3	23	11	22	13
D3	2	1	6	1
A2	2459	965	2565	889
B2	224	84	260	113
C2	28	13	36	12
D2	11	1	3	2
A1	5839	5417	7730	5212
B1	185	158	264	135
C1	67	11	35	10
D1	45	3	12	1
E	6	6	23	2
F	19	11	12	10
G	7	1	16	2
H1	22	21	22	12
H2	110	130	204	89
I1	0	0	0	0
I2	12	0	13	1
A4+B4+ C3+C4+D3+D4	139	47	138	52
Total faults	9581	6949	11654	6640

Table 6 —Tensile properties of yarn samples

Property	Sample 1	Sample 2	Sample 3	Sample 4
Breaking force, gf	217.01	225.18	216.01	231.44
Breaking tenacity, RKm	21.31	22.12	21.22	22.73
CV% of breaking force	12.04	11.65	12.44	12.39
Breaking elongation, %	8.38	8.30	8.47	8.50
CV% of elongation- at-break	10.95	11.1	21.03	11.57

3.2 Classimat Faults

It can be seen from Table 5 that number of objectionable faults (A4+B4+C3+C4+D3+D4) is maximum in Samples 1&3 and minimum in Samples 2&4. In the blowroom blended Samples, two times processing of cotton at card results in better individualisation and hence lower drafting related faults. The total number of faults is in the order of Sample 2 < Sample 4 < Sample 1 < Sample 3. More number of processing at card and comber reduces trash and neps present in the material.

3.3 Tensile Properties

Table 6 shows that single yarn breaking strength of Samples 4&2 is more than that of Samples 1&3, due to less number of yarn faults and probably less number of weak places in Samples 2&4. There may be apprehension that the length of fibres would reduce due to two times processing of cotton at card in the case of Samples 2&4. To verify this effect, the fibres are removed from the yarn by detwisting and then analyzed for length properties. The length distribution is found to be the same in all the four cases, with maximum difference of 0.5 mm in mean length. Hence, higher breaking strength of Samples 2&4 may be due to less number of faults present in the yarn. The elongation-at-break for Samples 4&3 is found to be higher compared to that of Samples1&2 though statistically not significant, except between Samples 2&4. The reason may be that the residual elongation of uncombed fibres in the yarn of Samples 3&4 upon loading is higher than that of combed fibres in the yarn of Samples 1&2.

The CV% of tensile strength and elongation-at-break is low for Sample 2 and high for Sample 3. The CV% of strength depends on the variation in number of faults and weak places present in the yarn along its length.

Table 7 — Blend proportion of yarn samples

Sample	Polyester	Cotton
1	64.33	35.67
2	66.57	33.43
3	66.02	33.98
4	65.99	34.01
Nominal	65.00	35.00

3.4 Blend Proportion

Table 7 shows the blend proportion of yarn samples. The nominal blending is in the ratio of 65:35 of P:C. It is found that the blend proportion deviates from the nominal by maximum of ±1.6%. The blending irregularity with respect to method of blending has already been carried out earlier by many researchers[1-4, 8], and hence it is not studied in this work.

The imperfections, tensile properties and classimat faults of the samples show that the quality is better for Sample 2 (blowroom blending and semi-combing of cotton) and Sample 4 (blowroom blending and super-carding of cotton), and inferior in the case of Sample 3 (drawframe blending and super-carding of cotton). Compared to the yarn produced using semi-combing and drawframe blending (Sample 1), the yarn produced using blowroom blending and super-carding (Sample 4) gives better quality in most of the cases. Hence, the polyester-cotton blended yarn may be produced by adopting super-carding of cotton and blowroom blending instead of widely used semi-combing of cotton and drawframe blending as super-carding is economical compared to semi-combing due to lesser number of processes.

4 Conclusion

4.1 The yarn produced using blowroom blend method gives better qualities in terms of imperfections, unevenness %, yarn faults and tensile strength both in the case of super-carded, and semi-combed cotton than that of the yarn obtained by drawframe blending method.

4.2 The elongation-at-break of yarn from super-carded cotton is better than that of semi-combed cotton.

4.3 The CV% of tensile strength and elongation-at-break is low for the yarns produced by semi-combed cotton, blowroom blending method and high for super-carded cotton, drawframe blending method.

4.4 Compared to the yarn produced using semi-combing of cotton and drawframe blending, the yarn produced using super-carding of cotton and blowroom blending gives better quality.

References

1 Lord Peter R, *A Handbook of Yarn Production: Technology, Science and Economics*, (The Textile Institute, Manchester), 2003, 164, 398, 128.
2 Klein W, *The Technology of Short Staple Spinning* (The Textile Institute, Manchester), 1998, 1, 21.
3 Lund G V, *J Text Inst*, 43 (1952) 375.
4 DeBarr A E & Walker P G, *J Text Inst*, 49 (1958), P353.
5 Lund G V, *Text Res J*, 24 (1954) 759.
6 Lund G V, *Text Res J*, 25 (1955) 265.
7 Balasubramanian N, *J Text Assoc,* 41 (2003) 173.
8 Punj S K, Mukhopadhyay A & Basu B, *Indian J Fibre Text Res*, 24(1999) 247.