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Spinning Performance and Yarn Properties of Multiple Filament Polyester/cotton Core Yarn

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Abstract: Polyester has many outstanding properties as a textile material viz. high wet and dry resistance, dimensional stability under wet and dry conditions and high strength. Keeping in view the unique properties offered by the polyester, the study was conducted to produce cotton covered/polyester core yarn on a modified ring frame. Such a yarn has cotton like feel and much higher strength than pure cotton yarn. The results showed that the yarn properties were effected by the percentage of polyester filaments in the blend. Similarly twist factor and roving positions also exerted highly significant influence upon count, lea-strength and CLSP value.

Keywords: Polyester Filament, Yarn Properties, Cotton Yarn

Introduction

Cotton has played a very important role in shaping the economical and political situation of the nations in the 20th century and will continue to dominate as one of the most important cash crop of the world, during 21st century. In Pakistan it provides 38 percent of the industrial employment and contributes 62 percent of industrial value addition. There are 442 textile mills in the country, with 8.35 millions spindles, 146 thousand rotors and 10000 looms. (Anonymous, 2000).

Filament core yarns are structures consisting of two component fibers one of which forms the center axis or core of the yarns and other the covering. Such a yarn usually consists of man made staple fibers or filament yarn core that is wrapped with cotton fibers. Core yarns have been used to improve the strength, durability, aesthetic and functional properties of fabrics. Previously Harper *et al.*(1986)stated that core spinning is a technique used to produce a yarn with a filament core and cotton wrap. This approach has been used to upgrade weaker fibres into finer counts.

Sawhney *et al.* (1988) produced a unique polyester core/cotton wrap composite yarn on a slightly modified ring spinning frame. This new device has successfully produced polyester staple core/ cotton wrap yarn of coarse, medium & medium fine counts. The core-spinning device is extremely effective in controlling the fibre wrapping process especially for the coarse to medium fine yarns and is easily adaptable to an existing spinning frame. Likewise Saleem (1999) described the yarn with filament core and staple fibre spun around it and explained that the filament is introduced at the drafting arrangement, the ratio of this filament to the cotton fibre is controlled to meet the physical requirement.

Materials and Methods

The present study was carried out in the Dept. of Fibre Tech. University of Agriculture, Faisalabad and at the Crescent Textile Mills Ltd.,Faisalabad during the year 2000. The representative lint cotton samples of the variety K-68 were collected from the running stock of the Crescent Textile Mills (Ltd.) Faisalabad and polyester filament yarn was obtained from the local market.

A conventional ring spinning frame with a double apron drafting system was modified to accommodate cones of polyester filament yarn. The polyester filament was fed from the cone through a guide pulley to the front rolls of the drafting system. A porcelain guide located near the front roll was used to place the polyester filament in the center of the strand of drafted cotton fibres. The cotton for each feed was supplied from a single bobbin of roving.

Following variables were selected

- **Blending Ratios (B)** Polyester/cotton

B_1=100/0, B_2= 66/34, B_3= 50/50, B_4= 25/75,B_5= 0/100

- **Twist Multiplier: (TM)**

T_1= 3.0, T_2 = 3.3, T_3 = 3.75, T_4 = 4.0

- **Roving Position: (P)**

P_1 = One step left = 0.7 mm,
P_2 = One step right = 0.7mm
P_0 = Central position = 0
P_3 = Two step left = 1.4 mm
P_4 = Two steps right = 1.4mm

At ring frame yarn (17^s Ne) was fabricated from the samples at different blending ratios, roving positions and twist multipliers, the core yarn and tested for count, lea-strength and count strength product values.

Results and Discussion

Yarn Count: The statistical analysis of variance and comparison of individual treatment means among variables for count of core yarn shown in Table 1, indicated that the effect of roving positions as well as first order interaction B x T were highly significant while the blending ratio produced only significant affect. However the twist factor and all other interactions had non-significant affect on yarn count.

The mean values for different blending ratios i.e., B_1, B_2,B_3,B_4 and B_5 were 17.20, 17.11, 17.08, 17.12 and 17.11 respectively. B_1 differs significantly from other treatments except B_4. Previously Saleem (1999) described the yarn with filament core and staple fibre spun around it and explained that the filament is introduced at the drafting arrangement, the ratio of this filament to cotton fibre is controlled to meet the physical requirement.

The individual comparison of mean values for count at different roving positions had shown highly significant affect. The mean values for different roving position i.e.,

P_1, P_3, P_0, P_4 and P_2 were 17.15, 17.20, 17.12, 17.04 and 17.07 respectively. The values for P_1 and P_3 were at par while P_2 differ significantly from P_3, P_4 and P_5. Rehman (1990) reviewed that the yarn produced by different mills in Pakistan possesses high variation in count as compared to the standard variation in count. Yarn faults i.e. high variation in yarn strength, high twist variation and high yarn irregularity, are greatly influenced by increase in count variation of yarns.

Yarn Lea Strength: The statistical analysis of variance and comparison of individual treatment means among variables for lea strength shown in table 2 (a and b) revealed that the blending ratio, roving position and twist factor produced highly significant effect upon lea strength for 17^s filament core blended yarn. Even the interactions produced highly significant effect.

The individual mean values for lea strength at different polyester blend ratios i.e. B_1, B_2,B_3,B_4 and B_5 were 314.0, 238.8, 225.9, 236.5, and 235.4 pounds respectively.

The maximum lea strength value 314.0 lbs. was obtained at B_1 (100% percent polyester) and minimum 225.9 lbs. at B_3. All of the values were found significantly different from each other. These results show that maximum lea strength was obtained for pure polyester and the lea strength decreased gradually by decreasing the polyester content except at B_3 (50% cotton + 50% polyester). These findings get support from the work of Sawahney *et al* (1988) who stated that core provides high strength, easy care and other functional characteristics while the outer wrap provides excellent traditional look, feel and comfort of cotton. Filament core yarns of 38% high tenacity polyester filament core and 62% cotton wrap shown significant improvement in breaking strength and elongation over the equivalent or comparable regular yarns of intimate blends. Another convincing statement was advanced by Harper *et al.* (1986) who expressed that polyester in filament form might augment yarn & fabric strength at lower blend levels than does staple fibre.

The mean values for different roving positions i.e., P1, P_3, P_0, P_4 and P_2 were 245.6, 257.2, 245.4, 252.4 and 249.8 pounds respectively. The individual comparison of mean values of lea strength at different roving positions showed that these values are significantly different from each other and had highly significant effect except P_1 and P_0 which recorded non significant differences among each other. These results show that by decreasing strand spacing lea strength value also decreases. In a previous study Plate (1983) stated that in two-fold weaving yarn the strand spacing is the most important variable as the strand spacing increases, the length of the individual strands above the convergence point increases and the amount of twist that is available to trapping therefore also increases as a result the strength increased.

The mean values of lea-strength for different twist factors viz., T1, T2, T3 and T4 are 240.7, 248.6, 251.9 and 259.1 pounds respectively. The comparison of mean values for lea strength among different twist factors show that these values are significantly different from each other and the results also revealed that by increasing the twist factor lea strength value increases gradually. In a previous study Duckett *et al.* (1979) stated that the breaking energy values of the two levels of twist were combined in subsequent analysis involving frictional interactions between cotton and polyester.

Count Strength Product (CLSP): The statistical analysis of the data pertaining to the count strength product value showed that blending ratio, roving position, twist factor and there first and second order interactions had highly significant effect.

The comparison of individual treatment means among different blending ratios revealed that these values are significantly different from each other, the maximum count strength product value was obtained at B_1 and minimum at B_3. The mean values for B_1, B_2, B_3, B_4 and B_5 were 5451, 4125, 3898, 4085 and 4068 hanks respectively. Because maximum strength was obtained at B_1 therefore maximum CSP value is also obtained under B_1. The test data indicates that cotton wrap contributes to the over all yarn strength, although not in proportion to the percentage of cotton fibres in the yarn. These results get full support from Nawaz and Shahbaz (1994) reported that higher percentage of polyester in the blended yarn improves the count strength value.

The mean values for different roving positions i.e., P_1, P_3, P_0, P_4 and P_2 were 4254, 4463, 4246, 4354 and 4309 hanks respectively. It can be well described from the above results that when the distance of the strand spacing is increased the corresponding CSP value improves.

The mean values for T_1, T_2, T_3 and T_4 were 4169, 4307, 4341 and 4484 respectively. The comparison of mean values among different twist factors of the above results revealed that CSP value is directly proportional to the twist factor.

Table 1(a): Analysis of Variance for Count 17's Polyester Filament Core Spun Yarn

SOV	DF	SS	MS	F. Value
Blending Ratio (B)	4	0.340	0.085	2.7221*
Roving position (P)	4	0.497	0.124	3.9771**
Twist factor (T)	3	0.171	0.057	1.8206^{NS}
B X P	16	0.274	0.017	0.5488^{NS}
B x T	12	1.803	0.150	4.8077**
P X T	12	0.372	0.031	0.9916^{NS}
B X P X T	48	1.428	0.030	0.9518^{NS}
Error	100	3.125	0.031	
Total	199	8.010		

*Significant, ** Highly Significant, NS= Non Significant

Table 1b: Comparison of Individual Treatment Means for Count 17's Polyester Filament Core Spun Yarn

Blending Ratio	Mean	Roving position	Mean	Twist factor	Mean
B_1	17.20 A	P_1-	17.15 AB	T_1	17.14
B_2	17.11 B	P_3-	17.20 A	T_2	17.13
B_3	17.08 B	P_0	17.12 B	T_3	17.07
B_4	17.12 AB	P_4-	17.07 B	T_4	17.14
B_5	17.11 B	P_2-	17.07 B		

Any two means not sharing a letter in common differ Significantly at 0.05 % level of probability.

Table 2a: Analysis of Variance for Lea Strength 17's Polyester Filament Core Spun Yarn

SOV	DF	SS	MS	F. Value
Blending Ratio (B)	4	207782.9	51945.7	25972.8**
Roving position (P)	4	3902.87	975.72	487.85**
Twist factor (T)	3	8685.03	2895.01	1447.50**
B X P	16	0374.29	1273.39	636.69**
B x T	12	18184.45	1515.37	757.69**
P X T	12	5356.81	446.40	223.20**
B X P X T	48	26126.29	544.29	272.15**
Error	100	200.00	2.00	
Total	199	290612.70		

Significant, ** Highly Significant, NS= Non Significant

Table 2b: Comparison of Individual Treatment Means for Lea Strength 17's Polyester Filament Core Spun Yarn

Blending Ratio	Mean	Roving position	Mean	Twist factor	Mean
B_1	314.0 A	P_1-	245.6 D	T_1	240.7 D
B_2	238.8 E	P_3-	257.2 A	T_2	248.6 C
B_3	225.9 B	P_0	245.4 D	T_3	251.9 B
B_4	236.5 C	P_4-	252.4 B	T_4	259.1 A
B_5	235.4 D	P_2-	249.8 C		

Any two means not sharing a letter in common differ Significant at 0.05% level of probability.

Table 3a: Analysis of Variance for CSP of 17's Polyester Filament Core Spun Yarn

SOV	DF	SS	MS	F. Value
Blending Ratio (B)	4	64548436.6	16137109.2	224126.6**
Roving position (P)	4	1250325.0	0312581.2	4341.41**
Twist factor	3	2512738.76	837579.59	11633.05**
B X P	16	5973953.76	373372.11	5185.73**
B x T	12	5840197.58	486683.13	6759.49**
P X T	12	1597082.31	133090.19	1848.48**
B X P X T	48	7897075.31	164522.40	2285.03**
Error	100	7199.99	72.00	
Total	199			

Significant, ** Highly Significant, NS= Non Significant

Table 3b: Comparison of Individual Treatment Means for CSP of 17's Polyester Filament Core Spun Yarn

Blending Ratio	Mean	Roving position	Mean	Twist factor	Mean
B_1	5451 A	P_1-	4254 D	T_1	4169 D
B_2	4125 B	P_3-	4463 A	T_2	4307 C
B_3	3898 E	P_0	4246 E	T_3	4341 B
B_4	4085 C	P_4-	4354 B	T_4	4484 A
B_5	4068 D	P_2-	4309 C		

Any two means not sharing a letter in common differ Significant at 0.05% level of probability.

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