IMPACT OF TRIFLING QUANTITY OF POLYESTER ON PHYSICAL CHARACTERIZATION OF LOW TWIST ROTOR SPUN BLENDED YARN

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ABSTRACT *This study was planned to investigate the influence of small share of polyester fiber on properties of low twist rotor spun yarn especially yarn strength. Cotton/polyester blended yarns were prepared by Reiter R-40 with three different linear densities at low twist of 550 tpm. Two cotton polyester blend ratios i.e. (98:2) and (95:5) were investigated at all linear densities. Encouraging results were obtained with slight addition of polyester fiber with respect to yarn tensile strength, elongation and total imperfection as these properties were improved with increasing ratio of polyester fiber. Based on experimental findings negative effect on coefficient of mass variation and an insignificant influence on hairiness were observed.*

Key Words: low Twist, Rotor Spun Yarn, Cotton, Polyester, Tensile properties, Imperfection,

INTRODUCTION

Open end yarn has two major deficiencies, first low strength and secondly harshness. Harshness can be overcome by reducing the twist multiplier. This reduction in twist leads to decline tensile strength [1, 2]. Although yarn strength is not such a critical factor in knitting process as yarn is not subjected to very high tensions compared to weaving [3]. Further this strength loss can be improved with slight addition of polyester fiber as polyester is the most suitable high strength assisting fiber for cotton. Addition of low polyester content will also reduce spirality problem of cotton/polyester blended yarn as it affects both aesthetic and functional performance of end product [4, 5].

Due to multiple end uses blending of cotton /polyester fibers is a common practice in textile industry. Blending different types of fibers is a widely practiced means of enhancing the performance and the aesthetic qualities of a fabric [6]. The percentage of polyester increases the strength of blended yarn and the strength declines as the share decreases [7]. In comparison with 100 % cotton, cotton / polyester blends have higher breaking and abrasion strength. Percentage share of the particular fibers in the blends has the greatest influence on the yarn parameters of all blend variants. The quality parameters change in dependence on the percentage of cotton fibers in the blend. The two factor variance analysis carried out confirmed the significant influence of the blend composition on the yarn's basic quality parameters [8,9]. An increase in the percentage of polyester fiber in Cotton/Polyester blended yarns increased twist liveliness in both ring and open-end spun yarns, and consequently enhanced spirality distortion in the single jersey knitted fabrics produced from those yarns [5, 10]. Increased spirality arising from the higher polyester content in a cotton / polyester yarn of the same linear yarn density was attributed to the higher moduli and different cross sectional shapes of these two fiber types [4,11]. From various researchers findings it is also concluded that in fiber blending process selection of appropriate types of fiber and blend ratios is also a critical concern [12, 13]. In this study it was intended to investigate the effect of blending small quantity i.e. (2 and 5 %) of polyester fiber with cotton, on properties of yarn like elongation, evenness, imperfections, hairiness and particularly on tensile strength.

MATERIALS AND METHODS

Two types of yarn materials namely cotton and polyester, three linear densities i.e. 30, 35 and 40 tex and two blend ratios 98:2 and 95:5 were planned for blended yarn samples. Properties of cotton fiber were measured on Uster HVI 900 (High volume instrument) and are given on Table 1. Second component i.e. polyster of Terylene brand were procured from ICI (Pvt) Ltd. Test results for fineness, length, strength and elongation are summarized in Table 2.

For 100% cotton yarn samples raw material was opened cleaned and mixed with the aid of MBO (mixing bale opener) Uniclean (B11) and then Mixing opener (MO). Uniflex (B60) compressed the material to yield lap and through chute feed system supplied to card (C-51) after carding action card slivers were transported to Rieter RSB D 35 Drawing frame for the chores of drafting, blending and leveling. Intended for regularized sliver two passages were undertaken at this platform. Rieter R-40 was adjusted for 100% cotton and used to spun yarn samples of three different linear densities with low twist of 550 tpm at a rotor speed of 90,000 rpm.

For blended yarn samples after opening and cleaning the raw material at Uniflex (B-60) and MBO 3/3, mixed according to the required ratio i.e. (98:2 and 95:5). Mixed material through blend line of blow room was transported to Card C-51 for carding action. Rieter RSBD-35 drawing frame were used for chores of blending, drafting and leveling. Card slivers were processed twice through drawing machine in order to get an even and homogenous drawn sliver. Rieter R-40 rotor machine used to spun yarn samples of three

Table 1. Test outcomes of various quality parameters of Cotton

Parameter	Specification
Tenacity (gram/denier)	6.8 (60 cN/tex)
Elongation (%)	18
Staple length (mm)	38
Fineness (denier)	1.2
Moisture (%)	0.4
Crimps per centimeter	5
Colour	Semi-dull
Cross section	Circular

Table 2. Polyester fiber specifications

Properties	Measured values
Span Length 2.5 % (mm)	27.55
Span Length 50 % (mm)	13.08
Uniformity Index (%)	48.98
Micronaire (µg/inch)	4.70
Tenacity of Fiber Bundle (gm/tex)	43.44
Trash (%)	7.2
Moisture regain (%)	7.0

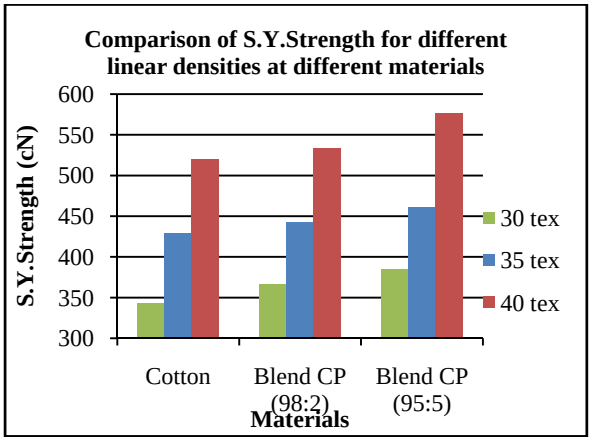

Fig. 1: Comparison of S.Y. Strength for different linear densities at different materials

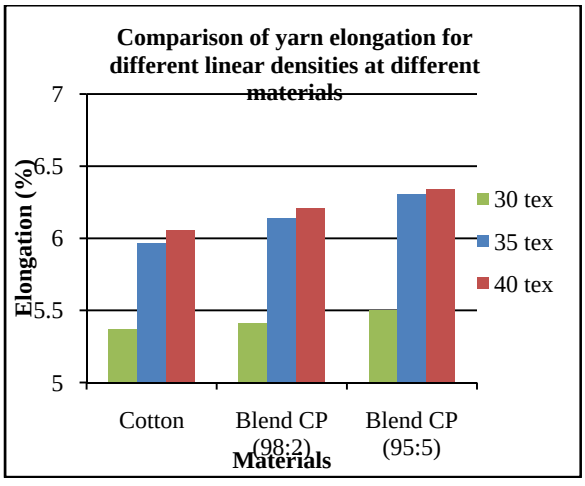

Fig. 2: Comparison of yarn elongation for different linear densities at different materials

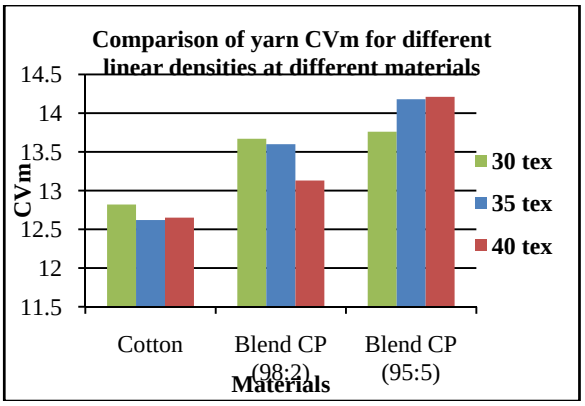

Fig. 3: Comparison of yarn evenness for different linear densities at different materials

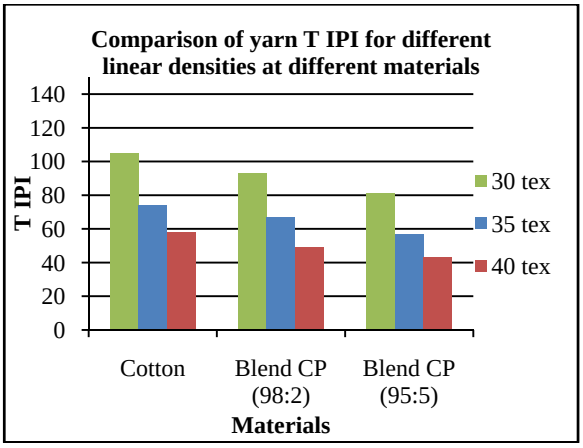

Fig. 4: Comparison of total imperfection for different linear densities at different materials

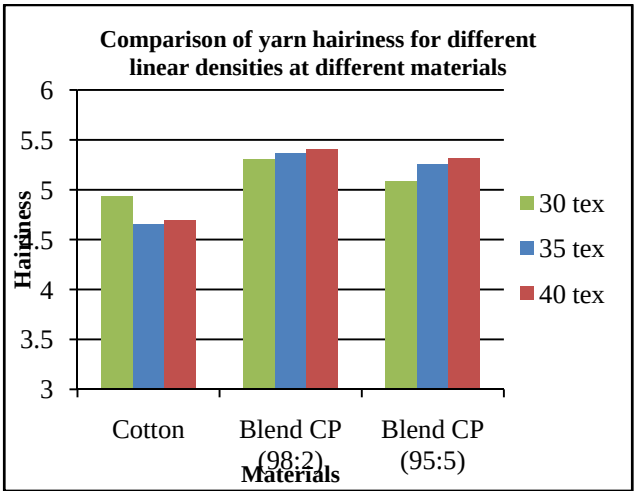

Fig. 5: Comparison of yarn hairiness for different linear densities at different materials

different linear densities i.e. 40, 35 and 30 tex with twist level of 550 tpm at a rotor speed of 90,000 rpm.

Yarn samples were conditioned at 20 ± 2º C and 65 ± 2 % relative humidity for 24 hours before testing. The characteristics of yarn samples were than measured according to ISO standard test methods [14]. Uster Tensorapid - 4 used to measure single yarn strength and elongation. 20 single measurements were performed for each bobbin (total 10 bobbins) and the mean values of the test

Table 3. Test results of cotton and blended yarns

No.	Quality Parameters	Cotton			CP blend (98:2)			CP blend (95:5)		
	Yarn linear densities (tex)	**40**	**35**	**30**	**40**	**35**	**30**	**40**	**35**	**30**
1	**S.Y. Strength (cN)**	**520.33**	**428.76**	**343.81**	**532.88**	**442.61**	**366.55**	**576.21**	**460.77**	**385.09**
2	**Elongation (%)**	**6.06**	**5.97**	**5.37**	**6.21**	**6.14**	**5.41**	**6.34**	**6.31**	**5.50**
3	**CV_m**	**12.65**	**12.62**	**12.82**	**13.13**	**13.60**	**13.67**	**14.21**	**14.18**	**13.76**
4	**T IPI**	**58**	**74**	**105**	**49**	**67**	**93**	**43**	**57**	**81**
5	**Hairiness**	**4.69**	**4.65**	**4.94**	**5.41**	**5.37**	**5.31**	**5.32**	**5.26**	**5.09**

Note: CP denotes cotton / polyester

results were used in analysis. Evenness, imperfection and hairiness were measured by Uster Tester- 4.

RESULTS AND DISCUSSION

Analysis of Strength and Elongation

To analyse the effect of yarn material on yarn strength, comparison of the data is shown in Fig.1. Figure 1 shows that the value of tensile strength of all yarn densities is continuously increased as the yarn material is changed from cotton to CP (95:5) blend. Same pattern is observed with respect to elongation as shown in figure. 2.

The reason for this improvement in yarn tensile strength and elongation can be explained as polyester fiber is not only stronger than cotton fiber but also possess higher elongation values [15]. When it is blended with cotton fiber, its high strength and elongation contributes its share towards yarn strength and elongation, as a result blended yarn becomes able to bear greater tensile load and exhibit supplementary elongation.

Number of fibers of each component in the yarn cross section also affects the mechanical properties of yarn [16, 17]. When the blended yarn is subjected to a force the components will be elongated, as the load increase relatively weaker cotton fibers with smaller elongation break first and then the entire load will be shifted to polyester fibers which according to their ratio in blend will deal it.

Analysis of Evenness

To analyse the effect of yarn material on yarn evenness, comparison of the data is shown in Fig.3. Values of coefficient of mass variation as described in figure 3 shows an increase with increasing polyster fiber content. This inferior quality parameter of blended yarn is due to the difference in physical structure and shape between cotton and polyester fiber. Furthermore, fewer amounts of individual fibers per unit cross-section in a blended yarn then corresponding 100 % cotton yarn also affects evenness as number of fibers in cross-section of a yarn has a determinant effect on its quality. Although preferably the constituent fibers should uniform in thickness and should contain same number of fibers in all the cross- section along its length to avoid this variation in mass but this is not possible on practical basis, however, it can be minimize. Imperfection usually increase as the yarn becomes finer [18]. Polyester fibers with different geometric features such as fineness, length and cross- sectional shapes improved the uniformity but deteriorated the imperfection level (i.e. coefficient of mass variation) of the yarn although they are confined within tolerance limit.

Analysis of total Imperfection and Hairiness

To analyse the effect of yarn material on yarn imperfection and hairiness, comparison of data is given in Fig.4 and Fig.5 respectively. Total imperfection improved with the introduction of polyester fibers as shown in figure 4. Reason in favor of this improvement is the supporting role of longer polyester fibers than cotton, which restrict the thick and thin places having length of about fiber length while neps are reduced due to decrease in short and immature fibers of blended material.

An insignificant effect of blending on yarn hairiness is observed with low polyester content in blend ratio which could be noticeable if polyester fiber ratio is higher than 5 %. Although longer polyester fibers reduced the number of protruding fibers but the effect is very low.

CONCLUSSIONS

A comparative study done to analyse the impact of blending trifling quantity of polyester fiber with cotton on properties of low twist rotor spun yarn. A range of yarn count was studied with 100% cotton and blend ratios of CP (98:2) and (98:5). It is concluded that tensile strength and elongation at all linear densities made from CP (98:2, 95:5) blends were higher than the yarns made from 100 % cotton. Which shows that blend ratios as well has a significant influence on mechanical properties of rotor spun yarn and blending ratios of polyester less than 25% can also improve strength and elongation factor which is a different result from some of earlier investigations. Furthermore, a decline in evenness is observed with addition of polyester content and it deteriorates with increasing polyester ratio. An insignificant influence on hairiness is observed at all linear densities with low polyester content in blend ratios.

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