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Research Article

Effect of Blend Ratio on Quality Characteristics of Polyester/Cotton Blended Ring Spun Yarn

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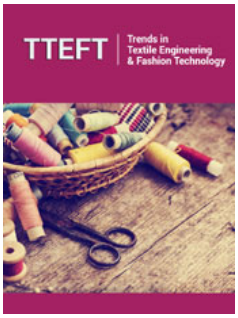

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Abstract

Cotton is a cool, soft, comfortable and is the principal clothing fiber of the world. Cloths made of this fiber absorb and release perspiration quickly, thus allowing the cloth to "breath." The advantages of polyester over cotton fibers are its strength, brightness, easy-care, low price, consistency in quality and availability. But it has low moisture regain (0.4%) as compared to cotton (8%). There is no perfect fiber that contains all the qualities of cotton and polyester mentioned above. In this context, blending is the technique to combine fibers which emphasizes the good qualities and minimizes poor qualities of the fibers. In blends of polyester/cotton, the fibers provide crease recovery, dimensional stability, tensile strength, abrasion resistance, moisture absorption, drape ability, etc. Different blend ratios of P/C have been considered for experiment, i.e., 100% cotton, CVC (60% cotton, 40% polyester) and PC (50% cotton and 50% polyester). In this work, we studied the yarn characteristics with several P/C blend ratios of 30/s Ne. Here, the properties of blended ring spun yarns are compared with the same of 100% cotton yarn and the results are discussed in terms of the following quality parameters: Mass irregularity (CV% and U%), Thick, Thin & Naps (IPI: Imperfection Index), CSP, single yarn strength and Hairiness.

Keywords: Polyester-cotton blend; Blending ratio; Yarn properties; Performance of blended yarn

Introduction

Blending of various fibers is extensively practiced for uplifting the performance and the aesthetic properties of cloth. Blended of natural fibers with man-made ones can provide the benefits of combining the good properties of both fiber components, such as comfort, softness, strength etc. These advantages also allow an increased variety of products to be made and deliver a stronger marketing advantage [1]. Reckoning of the performance of blended yarns has also been studied by numerous authors [2-5]. Natural fibers and their blends with man-made fibers improve the performance characteristics. They may be used for clothing, underwear, socks, hygienic, textile products as well as for composites [6]. Blending in the cotton spinning process has the aim to make yarn with suitable quality and cost. Use of adequate machines and techniques to select bales and knowledge of its characteristics is necessary to produce a good quality blend [7]. Years back, it had been a common practice to carry out the blending of natural and synthetic fiber in sliver form on the draw frame. The best blend in longitudinal direction was obtained in this way [8]. Department of Textile Engineering, Bangladesh. Li & Yen [9] investigated that, fiber properties have a significant effect on yarn strength. However, Nawaz [10] concluded that the gradual decrease in yarn strength occurs as the share of polyester fibers in the blend decreases. Anandjiwal & Goswami [11] suggested that blending dissimilar fibers lead to their non-uniform distribution throughout the yarn cross section, which in turn, lead to preferential migration depending on both fiber properties and mechanism of spinning process adopted. Therefore, the present study was carried out to figure out the effect of polyester/cotton blend ratio on quality characteristics of resultant yarn.

Methodology

The study was conducted in a well-known spinning mill situated at Gazipur, Dhaka, Bangladesh to see the quality of polyester-cotton blended yarn with respect to blending ratio. In Table 1 & 2 the details of the machineries and equipment's, used in this study, is given. For

the purpose of experiencing the quality of polyester-cotton blended yarn the following cotton and polyester samples are consider, which are shown in Table 3-5 in details. After having the cotton and polyester with mentioned mixing ratio, the resultant yarn was observed for testing the performance depending on the blending ratio. Uster® evenness tester 4 was used to have the quality parameters and performance of the polyester-cotton blended yarn. Here, three types of blend ratio were considered for yarn count of 30s', i.e., KW (100% Cotton), CVC (60% cotton + 40% polyester) and PC (50% cotton + 50% polyester). The comparison of quality parameters of these three blends was subjected in this study, which is given in Table 6 & 7.

Table 1: Detailed overview of the production machineries use is given.

Machine/ Process	Model	Manufacturer	Country of Origin
Blow room (Cotton)			
Uniflock	A 1/2	Rieter	Switzerland
Uniclean	B10	Rieter	Switzerland
Unimix	B7/3R	Rieter	Switzerland
ERM-III	B 5/5	Rieter	Switzerland
Condenser		Rieter	Switzerland
Loptex		Optosonic	Italy
Dustex	SP-DX	Trutzschler	Germany
Bale Opener (Polyester)	CS	Trutzschler	Germany
Tuftomat (Polyester)	TO-T1	Trutzschler	Germany
Carding (Cotton)	C-50, C-60	Rieter	Switzerland
Carding (Polyester)	MK-6D	Cross roll	China
Draw Frame	DX7AH, DX8 & DX8-LT	Cross roll	China
Simplex	FL-100	Toyota	Japan
Ring Frame	UA33F	Howa	Japan
Winding	21C	Muratec	Japan

Table 2: Detailed overview of the testing equipment's used is given.

Testing Equipments	Origin
Uster® HVI Spectrum, Zellweger Uster	Switzerland
Uster®AFIS Pro, Zellweger Uster	Switzerland
Uster® Evenness Tester 4, Zellweger Uster	Switzerland
Uster® Auto Sorter 4, Zellweger, Uster	Switzerland
Uster ® Tensojet 4	Switzerland
Electronic Wrap Reel	Indian
Lea Strength Tester	Indian

Table 3: Mixing ratio of cotton fiber is given.

Cotton Used			
Origin	**Percentage (%)**	**MIC**	**Color Grade**
Uganda	17%	4.15	33-2
Zambian	20%	4.08	32-1
Togo	4%	4.01	31-3
Cameroon	39%	3.82	1-Nov
Benin	11%	3.86	31-3
Memphis	9%	4.74	41-1

Table 4: Lab testing summary of cotton fiber is given.

Cotton Identification						HVI Test				
Origin	**SCI**	**Mic.**	**M**	**U%**	**SFI**	**Strength**	**+b**	**+Rd**	**CG**	**UHML**
Uganda	147	4.15	0.84	84.2	2.4	32.7	10.8	69.7	33-2	29.61
Zambian	128	4.08	0.83	83	4.8	28.2	9.8	75.2	32-1	27.38
Togo	133	4.01	0.83	81.6	7.7	31.9	9.1	76.7	31-3	27.15
Cameroon	142	3.82	0.83	82.7	5.8	30.4	9.5	80.7	1-Nov	29.16
Benin	126	3.86	0.83	81.7	7.2	28.9	9.1	76.2	31-3	27.39
Memphis	132	4.74	0.85	82.9	5.8	31	8	75.2	41-1	29.19

SCI: Spinning Consistency Index, Mic: Micron Aire Value, M: Maturity Ratio, U%: Uniformity Ratio, SFI: Short Fiber Index, +b: Degree of Yellowness, +Rd: Degree of Reflexes, CG: Color Grade of Cotton, UHML: Upper Half Mean Length

Table 5: Ratio of polyester fiber is given.

Polyester Used			
Origin	**Percentage (%)**	**Denier**	**Length**
Virgin (China)	100%	1.4	32 mm

Table 6: Uster test result is given.

Nominal Count	CSP	U%	CV%	DR 1.5m (5%)	H	Thin (-50%)	Thick (+50%)	Neps (+200%)	IPI
30s' KW (100% Cotton)	2457	11.35	14.41	22.76	4.98	4.25	126	216.25	346.5
30s' CVC (60%+40%)	2902	10.11	12.8	13.96	4.66	1.25	50.25	150.55	202.05
30s' PC (50%+50%)	3121	10.1	12.75	13.5	4.41	1.2	49.75	126.75	138.06

KW: Carded Yarn for Weaving, CVC: Cheap Value Cotton, PC: Polyester-Cotton Blend, CSP: Count-Strength Product, CV%: Coefficient of Variance, DR: Drawing Ratio, H: Hairiness Value, IPI: Imperfection Index

Table 7: Results of single yarn strength tester is given.

Nominal Count	B. Force (cN)	Elongation (%)	Tenacity (cN/Tex)	R. Work (N.cm)
30s' KW (100% Cotton)	324.1	3.98	16.47	379.2
30s' CVC (60%+40%)	300.5	5.21	19.5	570
30s' PC (50%+50%)	410.9	6.8	21.2	812

B. Force: Breaking Force, R. Work: Work of Rupture

Results and Discussion

Effect of polyester/cotton blend ratio on u% & cv%

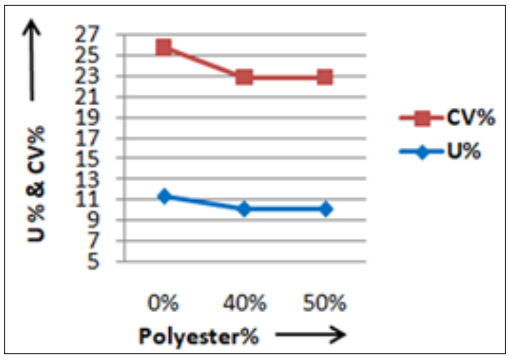

Figure 1: Effect of polyester/cotton blend ratio on u% & cv%.

Figure 1 shows the relationship between the yarn blend ratio and U% & CV% for various blend ratios of cotton and polyester. It is clearly revealed in the graph that U% & CV% decrease gradually with the increase in polyester proportion. We hereby infer that increase in polyester share in blend results in lower U% and CV% and that the increase proportion of polyester brings down yarn U% and CV% to an appreciable extent.

Effect of polyester/cotton blend ratio on thick +50%/km

A relationship between the blend ratio and number of thin places in the yarn for the various blend ratios was found. It is observed that the number of thin places in the yarn decreases with the increase in the polyester proportion in the blend, which is shown in Figure 2.

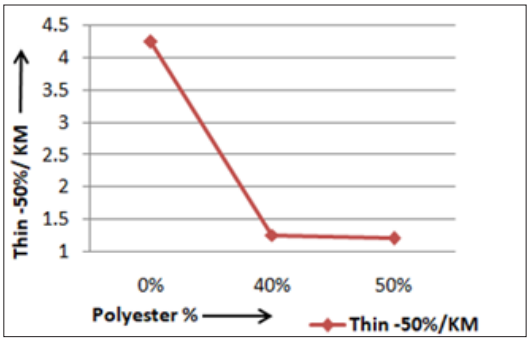

Figure 2: Effect of polyester/cotton blend ratio on thick +50%/km.

Effect of polyester/cotton blend ratio on thin -50%/km

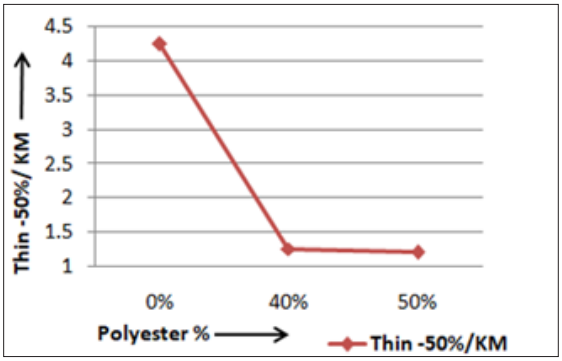

Figure 3: Effect of polyester/cotton blend ratio on thin-50%/km.

From Figure 3, it is observed that there is a relation between the blend ratio and number of thin places in the yarn for the various blend ratios. It is also observed that the number of thin places in

the yarn decreases with the increase in the polyester proportion in the blend.

Effect of polyester/cotton blend ratio on NEPS 200%/km

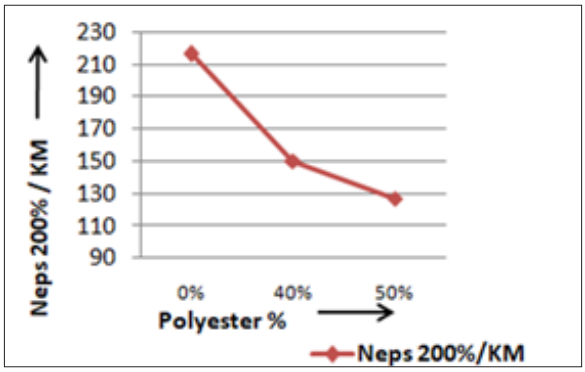

Figure 4: Effect of polyester/cotton blend ratio on NEPS 200%/Km.

The study revealed a relationship between the blend ratio and the NEPS 200% in the yarn per km. There is an inverse nature of NEPS (200%/km) with the increase in polyester proportion in the blend, which is shown in Figure 4.

Effect of polyester/cotton blend ratio on IPI [thick (+50%)+thin (-50%)+NEPS (+200%)]

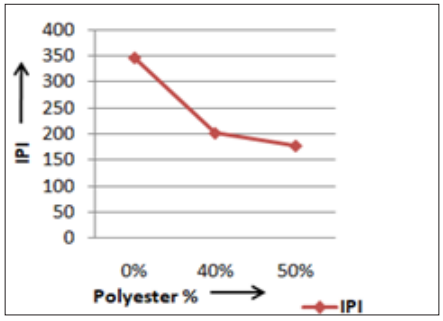

Figure 5: Effect of polyester/cotton blend ratio on IPI [thick (+50%)+thin (-50%)+NEPS (+200%)].

Figure 5 shows the relation between the blend ratio and the IPI in the yarn. IPI graph also shows an inverse nature with the increase in polyester share in the blend. So, an increase in polyester share in the blend has much lower IPI (Imperfections).

Effect of polyester/cotton blend ratio on CSP

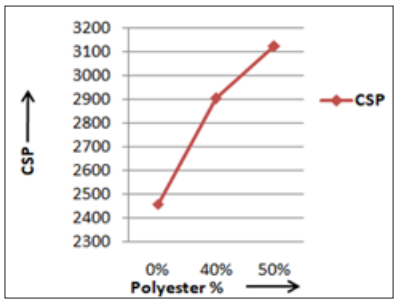

Figure 6: Effect of polyester/cotton blend ratio on CSP.

Figure 6 explains the strength values of the various blend ratio yarns. The graph reveals that increase in polyester proportion increases the yarn strength, which infers that an increase in polyester share in the blend has much higher CSP.

Effect of polyester/cotton blend ratio on hairiness

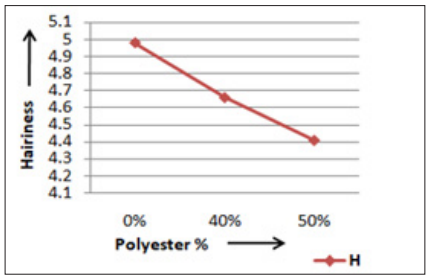

Figure 7: Effect of polyester/cotton blend ratio on hairiness.

A relation between blend ratio and hairiness index of the various blended yarns is stated in Figure 7. The nature of the graph shows that, an increase in polyester share in the blend decreases the hairiness of the yarn.

Effect of polyester/cotton blend ratio on strength

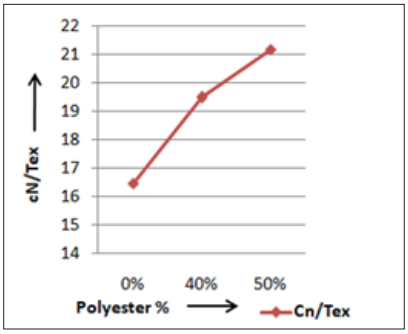

Figure 8: Effect of polyester/cotton blend ratio on strength.

Figure 8 determines the tenacity values of the blended yarns. The graph shows that the tenacity value increases with the increase in polyester proportion. We hereby infer that increase in polyester share in the blend has much higher strength.

Effect of polyester/cotton blend ratio on elongation at break

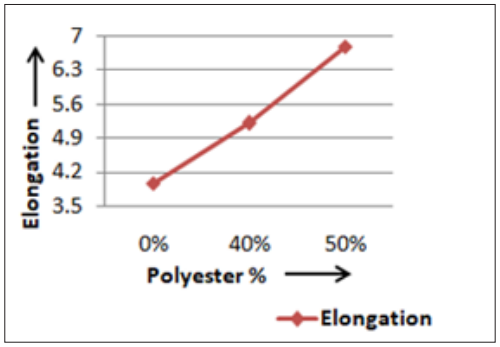

Figure 9: Effect of polyester/cotton blend ratio on elongation at break.

The elongation of the yarn for the various blend proportions is stated in Figure 9. The graph reveals that, there is an increase in extension with an increase in the polyester share in blend.

Effect of polyester/cotton blend ratio on work of rupture

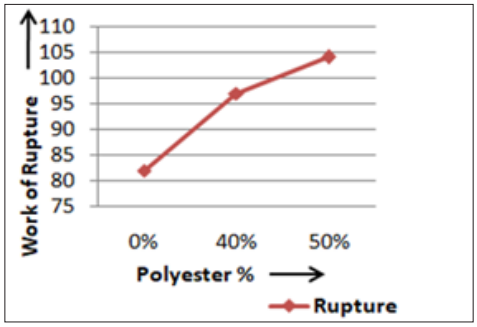

Figure 10: Effect of polyester/cotton blend ratio on work of rupture.

Figure 10 reveals the work of rupture values of the blended yarns, showing that the work of rupture value increases with the increase in polyester share in the blend.

Conclusion

The study was carried out to figure out the effect of polyester/cotton blend ratio on quality characteristics of resultant yarn. The study reveals that, with the increase in polyester share in the blend, the overall quality parameters of yarns are improved. Some of them are U%/CV%, IPI, Hairiness, CSP and single yarn strength. At the same time, moisture regain% of the yarns decreases with the increase in polyester share in the blend; Such as, for 100% cotton: MR is 8.4%, for 40/60 PC: MR is 5.7% and for 50/50 PC: MR is 5.0%. However, depending on the end uses, the optimum percentage of polyester and cotton may be adjusted.

Acknowledgement

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