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Evaluation of Processing Performance and Properties of 100% Cotton and Cotton-Polyester Blended Ring Yarns

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Abstract

The paper provides comparison of properties of 100% cotton yarn with those of two cotton-polyester blended yarns of 50/50 and 20/80 blend ratios. In this regard three types of yarns (i.e. 100% cotton, 50/50 and 20/80 cotton-polyester blends) were produced in the ring frame and for each type two different counts (30 Ne and 40 Ne) were produced. The blending was carried out in the draw frame. During processing, the settings and parameters e.g. spindle speed and twist multiplier were adjusted for optimum performance. After production at each stage (i.e. D/F, Simplex and Ring) samples of draw frame slivers, rovings and yarns were collected and investigated. The properties that were investigated were count, yarn faults, yarn irregularity as U% and strength as CSP. The study shows that, in ring frame it was possible to maintain higher spindle speed and lower twist multiplier for 50/50 and 20/80 blended yarns than 100% cotton yarn. Between 50/50 and 20/80 blended yarns, it possible to maintain higher spindle speed and lower twist multiplier for 20/80 blend than 50/50 bend. It was observed in all cases that as the percentage of polyester increase the U% i.e. the irregularity in the sliver/yarn decreases. It was also observed that yarn faults (IPI) decreased with the increase of % of polyester in the yarns. The yarn strength of 50/50 and 20/80 blended yarns was higher than that of 100% cotton and strength of 20/80 was higher than that 50/50 blended yarn.

Keywords: Blend; CSP; IPI; Irregularity

Introduction

Blending is the mixing of two different staple fibres. Textile fibres are blended for obtaining desirable properties in the yarn [1,2]. Some of the important properties that are attributed to a blended yarn are uniformity, technical and engineering, functional, aesthetic etc. Apart from this one of the important reasons for blending is to minimize production cost. Understanding its importance in textile industry and its rising cost [3]. This is done by improving quality and increasing productivity. Blending has enormous impact on the performance of spinning weaving and end use characteristics. Fibre properties during spinning are the most important properties. A high amount of yarn breaks during processing causes higher machine stops, higher piecing in the yarn and reduce machine efficiency [4]. Weaving performance of blended yarn is much better than 100% cotton yarns. This is due to the fact that the strength of blended yarn is better than 100% cotton yarn. It is believed that blending was first introduced to attribute crease resistance property on garments which is due to the presence of polyester. A blended fabric is more durable than that produced from 100% cotton. A perfect blend requires the use of appropriate raw materials, machine, and of course adequate knowledge and techniques. Blending of fibres is usually made with different fibres having dissimilarity in their properties. Blending is done to achieve or improve certain characters of the yarn or its processing performance. When natural fibre blends with classic fibres, the properties of the resultant yarns improves in many ways so that various high quality products e.g. clothing, underwear, socks, textiles products and composites can be made of these fibres. Yarn faults are the total number of neps, thick and thin places in a given length of yarn. For ring spun yarn faults badly affect the yarn and fabric quality. Yarn contains more yarn faults exhibits poor appearance, lower strength and poor performance in weaving and will produce low quality fabric [5]. It is serious when a fault appears at regular intervals along the length of the yarn. In this case the faults will be located in a pattern that is very clearly visible to the eye. Imperfection generates defects like stripes, barre or other visual faults in the cloth. After dyeing these faults are compounded [6]. Evenness of the yarn is the variation of mass per unit length. Evenness can affect some properties of textiles, like appearance of the fabric [7]. Yarn evenness causes variation of strength in the yarn. An irregular yarn breaks more easily during processing because of stress [6]. Other fabric properties such as abrasion, absorbency, reflectance or luster may be influenced by yarn evenness. The effects of irregularity are wide in all areas of the production and use of textile. The increment of polyester fibre in the blended yarn results pilling attitude falls down grade [8,9]. Influence favorably the behavior of the raw material during processing Blended yarn from natural and man-made fibre have advantage of successfully combining the good properties of fibre components, such as easy care properties. These advantages can causes stronger marketing and increased variety of product [10].

In this study 100% cotton yarn and two cotton/polyester blend yarn (50% cotton and 50% polyester, 20% cotton and 80% polyester were blended to produce ring-spun yarn. Maximum possible production speed and lowest possible Twist per inch (TPI) were used. Highest production without sacrificing quality was one of the key factors during production. Yarn strength, irregularity, Yarn faults including neps/km, thin/km and thick/km were studied.

Material and Methods

The works reported in this paper is the evaluation of processing performance and properties of 100% cotton (C) yarn and cotton-polyester blended (CPB) yarn having 50% cotton-50% polyester (CPB1) and 20% cotton-80% polyester (CPB2) blend ratio. In this regard three

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types of ring yarns each with 30 and 40 counts were produced at Yeasmin Spinning Mills Ltd., Sreepur, Gazipur, Bangladesh. Raw cotton fibres were originated from Cameroon and Chad. The particulars are shown in Table 1.

For spinning yarns, both cotton and polyester fibres were processed separately in blow room and carding. The two types of card slivers (100% cotton and 100% polyester) were blended draw frame according to their percentage. For blending of cotton-polyester three draw frames were used and two draw frames were used for 100% cotton process.Two blend ratios of cotton-polyester were taken for comparing with100% cotton yarn. The detail plan of blending is shown in Table 2. In every stage of manufacturing, produced sliver, roving and yarn were tested. Fibre were tested by high volume instrument (HVI), Irregularities as U% and Yarn fault (IPI) were tested by Uster tester (UT-4). Yarn count was measured by Wrap Reel and Balance method. Yarn strength was measured in count strength product (CSP) using Lea Strength Tester. Yarn twist was tested by twist tester. All the tests were done in Standard testing condition.

Results and Discussion

Tables 3-5 shows that irregularity in breaker and finisher draw frame slivers and in roving. In all cases it is seen that the irregularity decreased with the increase of polyester percentage. The aspect of fibre fineness and uniformity in length is better in polyester than 100% cotton. These may be the reasons for decreasing of irregularity in the polyester blended yarns.

During production of the three types of yarns, attempt has been made to utilize maximum possible spindle speed to maximize production. Table 6 shows that the spindle speed was higher and TM lower for cotton-polyester blends than C yarns. More spindle speed and less twist means higher production. Higher spindle speed in C roving causes more breakage in ring frame results decrease in the quality of yarn. Lower twist in C yarn can causes insufficient strength of yarn. These factors mainly determine by strength and length of fibre. In polyester fibre strength and length may better than cotton fibre. As a result, it was possible to maintain higher spindle speed and lower twist for CPB1 and CPB2. Further to this the spindle speed was higher and twist was lower for CPB2 than CPB1. Table 7 shows that strength is higher for CPB1 and CPB2 yarns than C yarns. Yarn strength mainly influenced by fibre strength, fibre length and fibre fineness etc. All these properties are higher in man-made polyester fibre than natural cotton fibre. As a result, yarn strength increase with the increase of polyester percentage in the yarns. Since the % of polyester is higher in CPB2 therefore its strength was higher than that of CPB1 yarns. Table 8 shows that the yarn faults (IPI) were lower in CPB1 and CPB2 than C yarns. A yarn fault (IPI) of yarns largely depends on fineness fibre. Fineness is higher in man-made fibre than cotton fibre used in this study. May be for this reason, yarn faults (IPI) decreased with the increase of share or % of polyester in the yarns.

Conclusion

This study is comparison between 100% cotton yarn and cotton-

Properties	Cameroon	Chad
Length (mm)	30.29	28.79
Uniformity	83.4	82.9
Fineness (μg/inch)	4.50	4.56
Strength (GPT)	29.8	29.1
Maturity	0.88	0.88
Polyester staple fibre was Virgin china with length 32 mm, Fineness 3.95 μg/inch.		

Table 1: Particulars of cotton fibres.

Process	Breaker daw frame (grain/6yds)		Finisher draw frame 1 (grain/6 yds)	Finisher draw frame 2 (grain/6 yds)
C	420*5 doubling		420*8 doubling	
CPB1	Cotton 465*3 doubling	Polyester 390*4 doubling	385*8 doubling	380*8 doubling
CPB2	Cotton 340*2 doubling	Polyester 460*6 doubling	335*8 doubling	330*8 doubling

Table 2: Plan of blending in breaker draw frame.

Yarn Type	U%	CVm%	CVm% 1m
C	2.58	3.26	0.85
CPB1	2.56	3.25	1. 30
CPB2	2.48	3.13	1.27

Table 3: Quality of breaker draw frame slivers.

Process	U%	CVm%	CVm% 1m
C	2.35	2.94	0.56
CPB1	1.95	2.70	0.74
CPB2	1.72	2.15	0.63

Table 4: Quality finisher draw frame slivers.

Process	U%	CVm%	CVm% 1m	CVm% 3 m
C	4.07	5.13	1.85	1.18
CPB1	3.05	3.83	1.19	0.71
CPB2	2.99	3.57	1.60	1.10

Table 5: Quality of roving's in simplex.

Parameters	30 Ne			40 Ne		
	C	CPB1	CPB2	C	CPB1	CPB2
Actual count	30	30.20	30.10	40	40.15	40.20
Spindle speed	15000	16000	16500	16000	17000	17500
Break draft	1.13	1.15	1.16	1.13	1.15	1.16
Roller gauge	44*54	45*65	45*65	44*54	45*65	45*65
TPI	20.97	19.20	17.45	25.01	24.17	23.05
TM	3.82	3.50	3.18	3.95	3.82	3.64
Spacer	Yellow	Yellow	Yellow	Red	Red	Red

Table 6: Particulars of ring frame setting used for different quality of yarns.

Process	Count 30 Ne			Count 40 Ne		
	Average count	Average lea Strength	C.S.P	Average count	Average lea Strength	C.S.P
C	30.02	92.07	2764	40.05	65.15	2609
CPB1	30.10	116.20	3497	40.02	86.75	3471
CPB2	30.15	129.36	3901	40.10	94.26	3780

Table 7: Yarn count and strength test for different blend yarns.

Count	Blend	U%	CVm%	Thin (50)%	Thick (+50)%	Neps (+200) %	IPI (thin + thick + neps)
30Ne	C	11.22	14.33	2.5	142.5	274	419
	CPB1	9.92	12.59	0	49.5	108	157.50
	CPB2	9.70	12.12	0	42.5	99	141.50
40Ne	C	11.40	14.35	7.5	190	395.5	593
	CPB1	10.69	13.58	2.5	94	178.5	275
	CPB2	11.28	14.28	13.5	93	160	266.50

Table 8: Yarn quality found in ring frame.

polyester blend yarn. The most important fibre properties required in ring-spinning are greater in polyester fibre than cotton fibre. As a result, it was observed the yarn strength increases with the increase of polyester percentage in the yarns. When percentage of polyester increases the evenness in the yarn increases. In the ring frame it was possible to maintain more spindle speed and lower twist for blended yarn than 100% cotton yarn. Between the two blended yarns, the spindle speed was higher and twist was lower for higher percentage of polyester. It was also seen that yarn faults decreased with the increase of share or % of polyester in the yarns. It may be said that, for a spinner processing cotton-polyester blend is more convenient than processing 100% cotton regarding both production and quality.

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