INTERACTION STUDY OF POLYESTER AND MULTI BLEACHED COTTON BLENDS FOR THE TENSILE PROPERTIES OF ROTOR SPUN MÉLANGE YARN

Nasir Mahmood[1]*, N.A.Jamil[1], M. Arshad[2], M.Q. Tusief[1] and M. Iftikhar[1]
[1]Department of Fibre Technology University of Agriculture, Faisalabad
[2]Department of Irrigation and Drainage, University of Agriculture, Faisalabad
*Corresponding author's e-mail: nasirmahmood23uaf@yahoo.com

The textile industry being the backbone of Pakistan's economy needs to improvement due to the introduction of various factors like increasing competition in the global market place, introduction of state-of-the-art technology in textile field, high raw material prices, quality of raw material etc. Mélange yarn is a blend of different coloured fibres to develop various shades in the yarn. Difference in the ratio of fibres in the blend alters the uniqueness of spun mélange yarn. Therefore the present study was planned to evaluate the interaction of cloured polyester and multi bleached cotton blends for the tensile properties of rotor spun mélange yarn.
Key words: Bleached cotton, polyester, shaded colors, rotor spun yarn

INTRODUCTION

Increase in the world population and ever changing fashion demands for the change of textile raw materials. Customer's demand for quality product can only be fulfilled by the selected blends of raw material and most wisely machinery set up. Spinning raw material is not always homogeneous in its characteristics. The blend of different types of fibres are normally preferred for enhancing the performance as well as esthetic values of fabric. Blend yarns of natural and man made fibres have the particular advantages such as comfort of wear and easy care parameters. These advantages thus permit to manufacturer to increase product range in order to meet the changing marketing style in fashion. The blending effect describes the interactive pattern between the different components in the resultant blend; in this regard three blending affect can describe here. Structural blending, this implies the extent of geometrical allocation of different fibre segments with in the structural boundaries of the fibre strand. Attributive blending, this indicate the extent of interaction of different fibre attributive with in the characteristics boundaries of fibrous assembly. Appearance blending, this indicates the extent of homogenization of color or component intensity in the fibre assembly.

Bleaching, in the original sense of the term, means the whole sequence of the purification processes for brightening, whitening and cleaning of fibres, yarns or fabrics regardless of whether it is carried out in preparation for dyeing or in the processing of undyed goods. The most common bleaches used on cotton textile materials are Sodium hypochlorite (NaOCl) and Hydrogen peroxide (H_2O_2). Sodium hypochlorite is quite strongly alkaline and there is no risk the PH can fall below 10, as may happen with bleaching powder. It has the advantage that no insoluble products are formed and any substances resulting from the bleaching reactions are readily washed out of the material. Therefore Sodium hypochlorite (NaOCl) is most suitable substitute of Calcium hypochlorite Ca $(OCl)_2$ now a days. The greatest challenge for the fashion industry is the designing of efficient yarn with correct choice of spinning process and raw materials. Mélange yarn is a touch of ecstasy in the knitwear spinning. The mélange yarn is gaining popularity in the market. The literary meaning of the word "Melange" is an unorganized mixture of various dissimilar items, whereas in textile process this yarn is a blend of different coloured fibres to develop a new shade of yarn. In addition to different coloured fibres different types of fibres, for example polyester, jute, flax are also used with cotton to produce required shades and affects. The blending of cotton with polyester in different ratios was found to improve certain properties of cotton as well as polyester fabric. The mechanical properties bursting strength, aerial density, abrasion resistance of the fabric increased significantly where as porosity, air permeability, drape coefficient, moisture regain and bending length decreased significantly with the increased polyester content in the blend.

MATERIALS AND METHODS

The research work was initiated in the Department of Fibre Technology, University of Agriculture, Faisalabad and partly conducted at Ihsan Cotton Products, Manga Road Lahore.MNH-93 cotton variety with Fibre length 27.34 & 27.50 mm, Fibre strength 27.68 & 27.40 g/Tex and Fibre Fineness 4.19& 4.15µg/inch respectively and

black polyester staple fibre with staple length 38mm, Strength 7g/den and Denier 1.2 were used for the present research study. This material was collected from the mill by adopting the standard techniques. Then Six blends of Polyester and the bleached cotton, B1= 10:90, B2= 20:80, B3= 30:70, B4= 50:50, B5= 70:30 and B6= 90:10, were prepared and processed in the spinning of the mélange yarn of count 10^s.

Then these samples were bleached with Sodiuum Hypochlorite (NaOCH) and Hydrogen peroxide (H_2O_2). The recipe for Sodium Hypochlorite was as Liquor Ratio 1:20, Sodium Hypochlorite 3g/Litre, Soda ash 2g/litre, Soap (Sandopan DCT)= 0.5g/L and this treatment was carried out under temperature $40C^o$ for 30 minutes. While the recipe for Hydrogen peroxide was as Liquor Ratio 1:20, Hydrogen peroxide 3g/L, Sodium hydroxide 2g/ L Stabilizer (SIFA)= 0.2g/L, Soap(Sandopan DCT) = 0.5g/L and this treatment was also carried out under temperature=95-$100C^0$ and PH=11-12 for 30 minutes. After the yarn manufacturing data was statistically analyzed.

Tensile Properties

Tensile properties i.e. Single yarn strength, Yarn Elongation and Rupture per kilometer were observed with Uster Tensorapid-3 which works on the principle of constant rate of extension (CRE). The principle describes the fact that the moving clamps are displaced at constant velocity as a result of which the specimen caught in between the stationary and moving clamps extended by a constant rate. The breaking tenacity was measured from the maximum force which was applied anywhere between the beginning of the test and the final rupture of the specimen. The breaking elongation of yarn was measured from the clamp displacement at the point of peak force. The procedure was described in the ASTM Standard (1997).

Analysis of Data

The data thus obtained was statistically analyzed by analysis of variance technique using factorial experiments with 5 replications as suggested by Faqir (2004). Using M-stat micro computer statistical program devised by Freed (1992).

RESULTS AND DISCUSSION

Single Yarn Strength

The statistical analysis of variance and comparison of individual treatment means for single yarn strength is given in Tables 1 & 2 respectively. The results reveal that the effect of bleaching and blending ratios is highly significant, while their interaction (AxB) remained non-significant. Duncan's multiple range test (Table-2) for the comparison of bleaching indicate that the highest value of single yarn strength 1001.07 grams is recorded for H_2O_2(A1) bleaching and the lowest value of 945.7 grams is recorded for NaOCl (A2) bleaching. The values differ significantly with respect to each other. These values are well supported by previous research as Sonu and Labhe (1982) studied that bleaching of cellulosic textiles by hydrogen peroxide (H_2O_2) in organic solvents gave good absorbency and strength. The results are also accordance with those of Valko (1955) observed that sodium hypochlorite (NaOCl) bleach causes a loss of tensile strength due to the decrease in the molecular chain length. As regards to the blending ratios the results reveal that the highest value of single yarn strength is 1404 grams for B6 (90:10) and lowest value 713.2 grams is recorded for B1 (10:90). The single yarn strength of other blending ratios have values of 1071, 977.4, 913.9 and 760.7 grams for B5 (70:30), B4 (50:50), B3 (30:70) and B2 (20:80) respectively. The results are well supported by Shahzad (2003) who narrated that the share of polyester in the blend and yarn tenacity is directly related to each other and further stated that under different blend ratios, tensile properties improved gradually as the share of polyester in the blend is increased. The present results are found similar to the finding of Nawaz et al. (1999) they concluded that the gradual decrease in yarn strength as the share of polyester fibre in the blend decreases. While Baykal et al. (2006) reported that when the polyester ratio is over 25% in the blended yarn, the yarn strength increases because there are sufficient polyester fibres in the yarn cross-section. If the ratio of one of the components is insufficient, the yarn's properties will not meet our expectations.

Rupture per kilometer (RKM)

The statistical analysis of variance and comparison of individual means for rupture per kilometer is shown in Tables-3&4 respectively. The results indicate that the effect of bleaching and blending ratios is highly significant; however their interaction (AxB) remained non-significant. Comparison of individual treatment means (Table-4) for bleaches indicate that the highest value of rupture per kilometer 17.53 g/tex is recorded for H_2O_2(A1) bleaching and the lowest value of 16.53 g/tex is recorded for NaOCl (A2) bleaching. The results differ significantly with respect to each other. In case of blending ratio the results show that the highest value of rupture per kilometer 24.69 g/tex is recorded for B6 (90:10) and lowest value of rupture per kilometer 12.35 g/tex is recorded for B1 (10:90). Rest of the values are 18.70, 17.11, 16.02 and 13.33 g/tex for B5

Table-1. Analysis of variance for single yarn strength (grams)

SOV	DF	SS	M.S	F-value	Prob.
Bleach (A)	1	45915.5	45915.5	93.2	0.0000**
Blending ratio (B)	5	3114369.2	622873.8	1264.8	0.0000**
AxB	5	5122.2	1024.4	2.0	N.S
Error	48	23637.9	492.4		
Total	59	3189045.1			

Coefficient of Variation = 2.28%** = highly significant N.S = Non- significant

Table-2. Comparison of individual treatment means for single yarn strength (grams)

Bleach	Single Yarn Strength	Blending Ratio	Single Yarn Strength
H_2O_2 (A1)	1001.07	B1	713.2 F
NaOCl (A2)	945.7	B2	760.7 E
		B3	913.9 D
		B4	977.4 D
		B5	1071 B
		B6	1404 A

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

Table-3. Analyses of Variance for yarn Rupture per kilometer (g/tex)

SOV	DF	SS	M.S	F-value	Prob.
Bleach (A)	1	14.99	14.99	63.28	0.0000**
Blending ratio (B)	5	980.70	196.10	828.0	0.0000**
AxB	5	2.303	0.461	1.944	N.S
Erro	48	11.37	0.237		
Total	59	1009.42			

Coefficient of Variation = 2.86% ** = highly significant N.S = Non- significant

Table-4. Comparison of individual treatment means for yarn rupture per Kilometer (g/tex)

Bleach	Rupture per Kilometer	Blending Ratio	Rupture per Kilometer
H_2O_2 (A1)	17.53	B1	12.35 F
NaOCl (A2)	16.53	B2	13.33 E
		B3	16.02 D
		B4	17.11 C
		B5	18.70 B
		B6	24.69 A

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

(70:30), B4 (50:50), B3 (30:70) and B2 (20:80) respectively. The results indicate that as the share of polyester in the blend decreases the rupture per kilometer (RKM) value also decreases. The present results are found similar to the finding of Li and Yan (1990) they concluded that fibre properties had a significant effect of yarn properties. While Anandjiwala and Goswami (1999) investigated that blending of dissimilar fibres lead to their non-uniform distribution throughout the yarn cross-section, which in turn lead to preferential migration depending on both fibre properties and mechanism of certain spinning process and he further stated that the relative disposition of fibres in the yarn in both the longitudinal and radial directions with respect to the yarn axis has a significant effect on the yarn structure and properties such as yarn bulkiness, tensile behavior and abrasion resistance.

Yarn Elongation

The statistical analysis of variance and comparison of individual means for yarn elongation is presented in Tables 5 & 6 respectively. The results reveal that the effect of bleaching and blending ratios is highly significant and their interaction AxB generated non significant effect upon data. Comparison of individual treatment means for bleaching reveal that the highest value of yarn elongation 6.8 percent is recorded for H_2O_2 (A1) bleaching and the lowest value of yarn elongation 6.5 percent is recorded for NaOCl (A2) bleaching. As regards to the blending ratios the results reveal that the highest value of yarn elongation is 9.6 percent for B6 (90:10) and lowest value 4.8 percent is recorded for B1 (10:90). The yarn elongation of other blending ratios have values of 5.2, 6.3, 6.7 and 7.3 percent for B2 (20:80), B3 (30:70), B4 (50:50) and B5 (70:30) respectively. This shows that as the share of polyester in the blend increases the value of elongation also increases. The present results are supported by the finding of Sheikh (1991) who concluded that the yarn elongation was very important in yarn spinning process. Yarn with low elasticity i.e. low elongation tends to break more frequently during fabric construction. While Ahmad (1991) reported that tenacity and elongation properties of single yarn were related directly to the fibre elongation of cotton from which they were spun. Whereas, Amjad (1999) reported that cotton elongation varies from 6-10 percent for various Pakistani cottons. Higher fibre elongation will result in better yarn elongation, required by subsequent process of weaving and knitting etc.

Table-5. Analysis of variance for yarn elongation (%)

SOV	DF	SS	MS	F-value	Prob.
Bleach (A)	1	2.262	2.262	68.70	0.0000**
Blending ratio (B)	5	150.7	30.14	915.6	0.0000**
AxB	5	0.334	0.067	2.027	N.S
Error	48	1.580	0.033		
Total	59	154.908			

Coefficient of Variation = 2.71%** = highly significant N.S = Non- significant

Table-6. Comparison of individual treatment means for yarn elongation (%)

Bleach	Yarn Elongation	Blending Ratio	Yarn Elongation
H_2O_2 (A1)	6.8	B1	4.8 F
NaOCl (A2)	6.5	B2	5.2 E
		B3	6.3 D
		B4	6.7 C
		B5	7.3 B
		B6	9.6 A

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

CONCLUSIONS

On the basis of present investigations, it is concluded that for yarn quality characteristics such as Single yarn strength, Rupture per Kilometer and Yarn Elongation of hydrogen peroxide (H_2O_2) bleaching found better than sodium hypochlorite (NaOCl) bleaching. Under different blend ratios, yarn tensile properties improved gradually as the share of polyester in the blend increased. Under different blend ratios, higher percentage of polyester fibres in the blend improved the yarn properties of polyester/ bleached cotton blended and in the same way; yarn tensile properties were also improved.

REFERENCES

Ahmad, M.M. 1991. Assessment of cotton. J. Text. Inst. and Leather Review 1(1): 44-51.

Amjad, M.1999. Relationship of cotton properties and yarn properties. Textech. Natl. Coll. of Text. Engg., Faisalabad: 102-104.

Anandjiwala, R.D. and B.C. Goswami. 1999. Structural property relationship of blended Cotton yarns made from low and high tenacity fibres. Text. Research J. 69(2): 129-138.

ASTM Committee. 1997. Standard test method for single yarn strength, Rapture per Kilometer and elongation. ASTM designation: D-2256-66. American Society for Testing and Materials, Philadelphia, USA.

Baykal, P.D., O. Babaarslan and R. Erol. 2006. Prediction of strength and elongation properties of cotton/polyester-blended OE Rotor yarns. Fib. & Text. in East. Europe 14(1): 18-19.

Faqir, M. 2004. Statistical methods and data analysis. Kitab Markaz, Bhawana Bazar, Faisalabad: 306-313.

Freed, R.D. 1992. M-Stat. Microcomputer Statistical Programme. Michigan State University of Agriculture, Norway-328 B. Agriculture Hall, East Lausing, Michigan Lausing, USA.

Nawaz, S.M., B. Shahbaz and C.K. Yousaf. 1999. Effect of different blends with various twist factors on the quality of P/C blended yarn. Pak. Text. J. 48(6): 26-29.

Shahzad. 2003. Comparison of knitted fabric from Air-jet and Ring spun yarn by selecting multiple blend ratios of cotton and polyester. M.Sc. Thesis, Deptt. of Fibre Tech., Univ. of. Agric., Faisalabad: 27-71.

Sheikh, H.R. 1991. Tensile strength an important yarn quality indicator. Pak. Text. J. 40(11): 12-19.

Sonu, Mrs K. and M.G. Labhe. 1982. Organic solvent bleaching with hydrogen peroxide. Inst. of Technol. Nagpur Uni., Nagpur, India. Colouraqe 29(19): 11-19.

Valko, E.J. 1955. Chemistry and chemical technology of cotton by Ward: Inter Science Publishers Inc., New York, USA ED. I: 117-215.