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Comparative Study of Quality Parameters of Knitted Fabric from Air-jet and Ring Spun Yarn

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Abstract: From the present research work it is concluded that properties of ring spun yarn are better than air-jet spun yarn. Under different blend ratios, yarn and fabric tensile properties improved gradually as the share of polyester in the blend was increased. However under two different yarn spinning systems (ring and air-jet), fabric strength, of ring spun yarn knitted fabrics is greater as compared to air-jet spun yarn. The results indicated that yarn and fabric strength as well as fabric weight showed highly significant effects of machine and blending ratio.

Key words: Knitted fabric, air-jet yarns, ring spun yarns, fabric strength

INTRODUCTION

In recent years knitted apparel have made impressive improvement in quality, volume growth and has the potential of leading Pakistan textile sector to the forefront of international textile trade. The use of knitwear (hosiery) has increased primarily due to its low price as compared to cotton and blended woven fabric. Knitting is a conversion system in which yarn loops are intermeshed to form a fabric. Being much more technically complicated than weaving, the historical development of knitting was delayed for thousands of years. There are two different method employed for knitted fabric i.e. wrap and weft knitting. In wrap knitting yarn used are laid side by side upon one or more wrap, whereas in weft knitting single yarn is fed from cone directly at a time to a multiplicity of needles in crosswise direction. Weft knitted structure especially those used for hosiery knit wear and under wear have unique properties of form fitting and elastic recovery based on the ability of knitted loops to change shape when subjected to tension.

Air-jet spinning, a successful commercial implementation of fascinated yarn technology is a pneumatic spinning method in which drafted strand of fibres is subjected to two successive opposing streams of air-jets between the delivery rollers of a conventional drafting system and a take up device.

In a previous study Basu[1] narrated that spirality of knitted fabric produced from ring, air-jet, rotor and friction spun yarn show that angle of spirality is minimum for air-jet yarn. He also concluded that the fabric made from air-jet spun yarn are thicker than ring spun yarn. While Punj[2] concluded that air-jet yarn knitted fabric exhibits higher compression and compressibility than ring spun yarn knitted fabrics. Also Candan *et al*.[3] stated that the knits from ring spun yarn posses more bursting strength than that of open-end spun yarn. Ertrugral and Nuray[4] reported that fabric weight, yarn breaking strength and yarn elongation are the major parameters that affect the bursting strength of knitted fabric. On the other hand Ruppenicker *et al*.[5] concluded that fabrics produced from the cotton/polyester blends generally had less shrinkage than all cotton fabrics.

Keeping in view the unique properties of air-jet yarn and knit fabrics and the significance of yarn quality upon fabric parameters, the research project to compare the performance of fabric knitted from ring and air-jet spun yarns for rotating ratios of polyester and cotton was designed.

MATERIALS AND METHODS

The research project was initiated in the Department of Fibre Technology, University of Agriculture, Faisalabad and conducted at the Crescent Textile Mills Ltd., Faisalabad during the year 2002-2003. The details of the material used and methods applied to test various quality characteristics of the fabric are briefly described here under.

Spinning process: MNH-93 and polyester staple were processed separately in blow room and carding section at normal machinery adjustments. The card slivers of polyester and cotton were fed to breaker drawing frame to produce the sliver of different blending ratios. They further processed through inter and finisher drawing frames to improve the blending, as well as uniformity of sliver. The slivers of 65 grains/yard were processed

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through simplex machine and then roving of 0.88 hanks fed to ring, while the sliver of 44 grains/yard fed to air-jet spinning machines to spun the 30s yarn. The following variables were selected for the manufacture of yarn and fabric.

Polyester/cotton blended spun yarns (both ring and air-jet spun) of 30's count were used in the study. The following variables were selected for the manufacture of yarn and fabric.

Machines		Blend ratio (polyester: cotton)	
M_1	Ring spinning	B_1	100:0 (pure polyester)
M_2	Air-jet spinning	B_2	80:20
		B_3	67:33
		B_4	50:50
		B_5	0:100 (pure cotton)

Yarn characteristics: All the yarn samples prepared were evaluated for the following characteristics by using standard techniques and the data was recorded for statistical interpretation.

Yarn count: The yarn count was estimated through Skein Method, according to ASTM Standard[6].

Yarn lea strength: Breaking strength of yarn was also determined by Skein Method, recommended by ASTM Standard[6] by using pendulum type lea strength tester.

Knitting process: Terrot brand circular knitting machine was used to knit S/J fabric. Yarn samples were spun for this research study by using two different spinning systems (Ring and Air-jet) and different blend ratios. Following specifications were engaged for the preparation of S/J knitted samples.

Machine dia	=	20 inch
No. of feeder	=	25
Cylinder dia	=	24 inch
Dial height	=	4 inch
No. of needles	=	1112

Knitted fabric samples thus produced, were conditioned for 24 h before testing at standard relative humidity 65±2 and 20±2% ºC temperature. The following fabric parameters were evaluated:

Fabric weight: Fabric density is the weight of fabric in grams, per unit area and was determined by according to ASTM Standard[7].

Fabric strength: Fabric strength is the force in pounds per square inch (Psi) which is used to burst the fabric and was determined according to the ASTM Standard[7].

Statistical analysis: The data thus obtained was analyzed statistically using two factor factorial Completely Randomized Design (CRD) by contrast comparison. Duncan's multiple range test was also applied for individual comparison of means among various quality characteristics as suggested by Faqir[8] using M-Stat micro computer statistical programme.

RESULTS AND DISCUSSION

Yarn count: The analysis of variance of data pertaining to the effect of machines (M) and blending ratios (B) elaborates that the effect of machines and blending ratios as well as their interaction (MxB) remain non-significant on yarn count.

Table 1 revealed that the highest and lowest values of yarn count (30s) are recorded as 30.19s and 30.12s for air jet (M_2) and ring (M_1) spinning, respectively. These results clearly identify that there is almost no difference between air jet and ring spun yarn as regards to yarn count and both processes exert extreme control and command over count. In a previous study Douglas[9] concluded that the yarn count, strength, irregularity and imperfections are influenced by raw material and also by the type, condition and setting of machine.

As regards to the blending ratios the highest and lowest of yarn number 30.08 and 30.33s are recorded for B_3 and B_1, respectively (Table 1). The rest of value are 30.16, 30.11 and 30.10s for B_5, B_2 and B_4, respectively. However the difference among all values is non-significant. On the other hand Rehman[10] found that actual value of yarn count spun from cotton or any other fibre, generally differ from nominal value.

Yarn lea strength: The statistical analysis of variance and comparison of individual means for yarn lea strength and results shows that the effect of machines and blending ratio is highly significant, but their interaction (MxB) remains non-significant.

Duncans multiple range test for the comparison of machines shows that the highest value of yarn lea strength (125.45 pounds) is recorded for ring spun yarn (M_1) and the lowest value of 106.42 pounds is recorded for air-jet spun yarn (M_2) (Table 1). These values differ significantly with respect to each other. These results are well supported by previous researcher Oxenham and Basu[11] who concluded that improvements in tensile properties can be achieved by small changes in jet design but it is obvious that the yarn strength achieved is significantly lower than can be achieved with other spinning systems.

As regards to the blending ratio the results reveal that highest value of yarn lea strength (146.16) pounds is recorded for B_1, followed by 128.80, 117.95, 102.79 and

Table 1: Comparison of individual treatment means for yarn count and yarn lea strength

Machine	Yarn count	Blending ratio	Yarn count
Ring (M_1)	30.12	B_1	30.33
Air-jet (M_2)	30.19	B_2	30.11
		B_3	30.08
		B_4	30.10
		B_5	30.16
Machine	**Yarn strength**	**Blending ratio**	**Yarn strength**
Ring (M_1)	125.45A	B_1	146.16A
Air-jet (M_2)	106.42B	B_2	128.80B
		B_3	117.95C
		B_4	102.79D
		B_5	83.98E

Note : Any two mean values not sharing a letter in common differ significantly at α=0.05 level of probability

Table 2: Comparison of individual treatment means for fabric weight (g) and tensile strength (Psi)

Machine	Fabric weight	Blending ratio	Fabric weight
Ring (M_1)	122.64B	B_1	133.19A
Air-jet (M_2)	127.78A	B_2	128.29B
		B_3	126.16E
		B_4	122.461D
		B_5	115.36E
Machine	**Fabric strength**	**Blending ratio**	**Fabric strength**
Ring (M_1)	104.49A	B_1	121.39A
Air-jet (M_2)	99.81B	B_2	113.21B
		B_3	108.76C
		B_4	100.54D
		B_5	66.84E

Note: Any two mean values not sharing a letter in common differ significantly at α = 0.05 level of probability

83.98 pounds for B_2, B_3, B_4 and B_5, respectively. The results clarifying that all these values differ significantly for different blending ratios. The highest values of yarn lea strength is recorded at 100% polyester and lowest value is recorded at 100% cotton. The results are in accordance with those of Shahbaz and Nawaz[12] who concluded that the yarn with higher percentage of polyester staple fibre shows more strength as compared to yarn with lower percentage of polyester.

Fabric weight The results of the analysis of variance and comparison of individual means for fabric weight reveal that the effect of machines and blending ratio is highly significant, but their interaction (MxB) is non-significant.

Duncans multiple range test (Table 2b) for the comparison of machines reveals that the higher value of fabric strength (127.78 g^{-2}) is recorded for fabric made by air jet spun yarn and lower value of 122.64 g^{-2} is recorded for the fabric made from air jet spun yarn. These values differ significantly from each other. From these results it is clear that air-jet spun fabrics are bulkier than ring spun yarn fabric. These results are strongly supported the findings of Basu[1] who mentioned that the fabric made from air jet spun yarn are thicker than ring spun yarn. Similarly Punj[2] observed that air jet spun yarn knitted fabric exhibits higher course^{-1} cm, wales^{-1} cm, stitch density and thickness than ring spun yarn. As air-jet spun yarn knitted fabric have higher course^{-1} inch than ring spun knitted fabric so air-jet fabrics are bulkier, the findings are at par with work of Shinn[13] who concluded that gain in weight is due to the increase in number of courses/inch.

As regards to the blending ratios the results reveal that the highest value of fabric weight (133.19 g^{-2}) is recorded for B_1 followed by B_2, B_3, B_4 and B_5 with their respective mean values 128.20, 126.165, 122.46 and 115.36 g^{-2}. From these results it is clear that fabric density increases as the share of cotton increases. The results are fully supported by Yousaf[14] who reported that with decrease in the share of polyester in blend, fabric density also decrease. Similarly Wegner[15] argued that yarn count and blend ratio were factor which effect the appearance of blended yarn and the fabric produced from it.

Fabric density depends upon fibre quality as Heap and Steven[16] reported that main yarn quality parameter the effect weight of knitted fabric were yarn twist and basic fibre quality. However Corbman[17] observed that the plain knit produces a relatively light weight fabric compared with the thicker fabric produced by other stitches.

Fabric strength: The results of the analysis of variance and comparison of individual means for fabric strength reveal that the effect of machines and blending ratio is highly significant, but their interaction (MxB) is remain non-significant.

Duncans multiple range test (Table 2b) for the comparison of machines reveals that the higher value of fabric strength (104.49 Psi) is recorded for fabric made from ring spun yarn and lower value of 99.81 Psi is recorded for the fabric made from air jet spun yarn (M_2). These results are significantly different with respect to each other. As fabric strength largely depends upon the yarn strength and ring spun yarn is stronger that air jet yarn so fabric made by the ring spun yarn is stronger. These results are fully endorsed by the research work of Basu[1] who reported that fabric produce from air jet spun yarn are weaker than fabric produced from ring spun yarn. On the other hand Punj[2] concluded that air-jet yarn knitted fabric exhibits higher compression and compressibility than ring spun yarn knitted fabrics.

As regards to blending ratios the results reveals that the highest value of fabric strength is 121.39 for B_1 followed by B_2, B_3, B_4 and B_5 with their respective mean values 113.21, 108.76, 100.54 and 64.84 Psi (Table 2). General trend of these values indicates a gradual decrease in fabric strength as share of polyester decreases. As the fabric strength largely depend upon yarn strength and the polyester rich yarn is stronger hence their fabrics is also stronger. These results are at par with the findings of Shahbaz and Nawaz[12] they concluded that the yarn blend with higher percentage of polyester staple fibre shows more strength as compare to yarn with lower percentage of polyester. Moreover, Ertrugral and Nuray[4] reported that fabric weight, yarn breaking strength and yarn elongation are the major parameters that affect the bursting strength of knitted fabric.

REFERENCES

1. Basu, Dr. A., 1999. Progress in air-jet spinning. Textile Progress, The Text. Inst. Manchester, UK., 29: 1-38.
2. Punj, S.K., 2000. Plain knitted properties. Text. Asia, 31: 33-38.
3. Candan, C., V.B. Nergis and Y. Iridag, 2000. Performance of open-end and ring spun yarns in weft knitted fabric. Text. Res. J., 70: 177-181.
4. Ertugrul, S. and T.R. Nuray, 2000. Predicting bursting strength of cotton plain knitted fabrics using intelligent techniques. Text. Res. J., 70: 845-851.
5. Ruppenicker, F., C. Kingsbery and A. Bouquet, 1977. Selection of optimum fibre properties for cotton knits. Text. Res. J., 47: 239-243.
6. ASTM Committee, 1997a. Standard Test Methods for Yarn Number, Lea Strength, ASTM Designations D: 1907-97, ASTM Standards on the Textile Material. Amer. Soc. Testing and Materials; 34th Edn. Part 33, Philadelphia, USA.
7. ASTM Committee, 1997b. Standard Method for Test for Weight, Bursting Strength, of the Knitted Fabric. ASTM Designation D: 231, D: 3787-89, D: 1905 and D: 3882-90. ASTM Standard on the Textile Material. Amer. Soc. Testing and Materials; 34th Edn. Part 33, Philadelphia, USA.
8. Faqir, M., 2000. Statistical Methods and Data Analysis. Kitab Markaz Bhawana Bazar, Faisalabad, Pakistan, pp: 306-313.
9. Douglas, K., 1989. Uster Statistics. Uster News Bulletin No. 36. CH-8610, Uster Switzerland, pp: 66-68.
10. Rehman, A., 1990. Studies in the evenness variation of cotton at various stages during spinning. M.Sc. Thesis. University of Agriculture, Faisalabad, Pakistan.
11. Oxenham, W. and A. Basu, 1993. Effect of jet design on the properties of air-jet spun yarns. Text. Res. J., 63: 674-678.
12. Shahbaz, B. and S.M. Nawaz, 1998. Strength and regularity of yarns, as influenced by different models of ring spinning frames. Pak. Text. J., 47: 26-29.
13. Shinn, W.E., 1957. Principles of Knitting. Clark Pub. Co. Charlotte, NC, USA., pp: 254-257.
14. Yousaf, K.C., 1998. Effect of different blending of P/C with various twist factors on the quality of plain knitted fabrics. M.Sc. Thesis, Univ. Agri., Faisalabad, Pakistan, pp: 47-59.
15. Wegner, W., 1981. Effect of fibres and processing conditions on blend irregularity. W. Text. Abst., 68: 99.
16. Heap, S.A. and J.G. Steven, 1994. Shrinkage you do not need to measure it to be able control it. Processing 36th Cong. Intl. Federation of Knitting Technology, pp: 107-117.
17. Corbman, B.P., 1983. Textile, Fibre to Fabrics. McGraw Hill Book Co. Singapore, pp: 104-123.