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OPTIMIZATION OF POLYESTER-FLAX BLEND RATIO FOR QUALITY YARN PRODUCTION

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Abstract: Generally yarn properties can be altered through blending of fibers and required properties can be achieved by using specific blending ratios. Polyester and flax blended yarn is very important in regard to both spinning performance and product quality. In this study polyester fiber was taken as a blending component with flax fiber. Flax and polyester have been a new blend now-a-days and depicts excellent properties than their individual yarn properties. Different proportion of flax and polyester has been tested by maintaining international standards to observe their yarn properties and it is found that polyester was perfectly compatible with low proportion of flax fiber. Their blends with specific ratios exhibit excellent properties which hence ultimately contribute to the fabric properties.

Keywords: *Polyester, flax, blend ratio and yarn quality*

1. INTRODUCTION

Flax is one of the oldest textile fibers used by mankind has unparalleled characteristics such as a feel of freshness and a magnificent brilliance [1]. It is very hygienic and imparts an air of satisfaction and style to the wearer [2]. Polyester fiber which is one of the most preferred among manmade fibers is widely used both alone and blend with other fibers [3]. Blending or mixing of natural and manmade fibers has been practiced for many years, but recently it has drawn a great attention from textile manufacturers [4]. It is now common practice to blend binary (two) or multiple (more) fibers together in order to produce yarns or fabrics with the required properties and end use [5]. Blended yarns from natural and man-made fibers have the particular advantage of successfully combining the good properties of both fiber components, such as comfort of wear with easy care properties. These advantages also permit an increased variety of products to be made, and yield a stronger marketing advantage [6]. Blend evenness can be measured in two ways. One is evenness in the longitudinal direction and another is evenness in the cross-section. Very stringent requirements are placed upon the blend evenness in the longitudinal direction. Deviations outside predetermined limits lead to uneven fabric appearance, strips, bars etc.[7]. In relation to the yarn cross-section, four types of component arrangement can be distinguished a) Homogeneous blend b) Radical blend c) Sectorial blend d) Segmental blend [8].The mass per unit length variation due to variation in fiber assembly is generally known "Unevenness" (in practice the U% value).The hairiness, H corresponds to the total length of protruding fibers divided by the length of the sensor of 1 cm. It is quality parameters of yarn. Imperfection means the total number of deviations, positive or negative, from the normal mass of a certain length of yarn [9].

2. MATERIALS AND METHODS

A. Materials

To produce polyester-flax blended yarn in ring spinning process polyester and flax fibers were taken. Polyester and flax is available in different forms but in this work staple polyester fiber and cottonized flax fiber were taken.

1) HVI report of flax and polyester fiber

The HVI report of flax and polyester fiber are given in table 1

Table 1: HVI report of flax and polyester fiber

Fiber properties	SCI	Fiber fineness (Denier)	Maturity	Length (mm)	Unf.	SFI	Strength (cN/tex)	Elg. (%)	Moist.	Rd	+b	C Grade
Flax fiber	91	2.57	1.09	32.95	71.1	13.5	47.27	2.1	6	43.1	14.0	85-5
Polyester fiber	-	1.4	-	38	-	-	40	15	-	-	-	-

B. Methods

In the thesis work polyester and flax fiber were used to produce polyester-flax blended yarn. After conditioning, flax fiber was used for blending. The recipe of emulsion for conditioning of flax fiber is giving below.

Water : 99.88 %

Softener : 0.12%

In this research work, 20 kgs of flax fiber was taken and 15% emulsion is applied on the weight of flax fiber. Then flax fiber is covered by heavy fabric on 20 hours for final conditioning. It has to be designed that, polyester and flax fiber are mixed in to four ratios and the ratios were polyester: flax = 95:05, 90:10, 80:20 and 70:30 designated as 95P/05F, 90P/10F, 80P/20F and 70P/30F.For this research work, blow room blending is used by maintaining blow room machineries. For sliver and roving hank, 69 grain per yard and 0.90Ne is to be produced to fulfill the requirements. Finally it has produced four different counts of yarn for individual ratio and that's were 20, 24, 26 and 30 Ne by using Ring spinning machine. For setting twist, 3.75 twist multiplier (TM) was used. Required and actual blend ratios, yarn count and TPI are shown in table 2

Table : 2 Required and actual blend ratios, yarn count and TPI

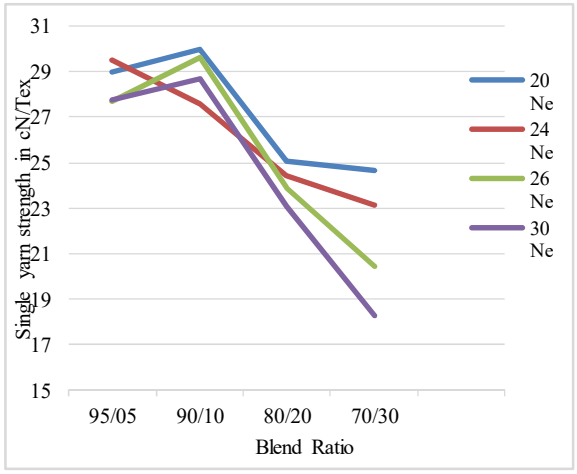
Required blend ratios	*Actual blend ratios*	*Required count (Ne)*	*Actual count (Ne)*	*Required TPI*	*Actual TPI*
95:05	93.4:6.6	20	19.99	16.76	18.73
90:10	88.2:11.8	24	24.02	18.37	20.71
80:20	80.8:19.2	26	25.86	19.12	21.72
70:30	67.4:32.6	30	29.97	20.54	22.21

3. RESULTS AND DISCUSSION

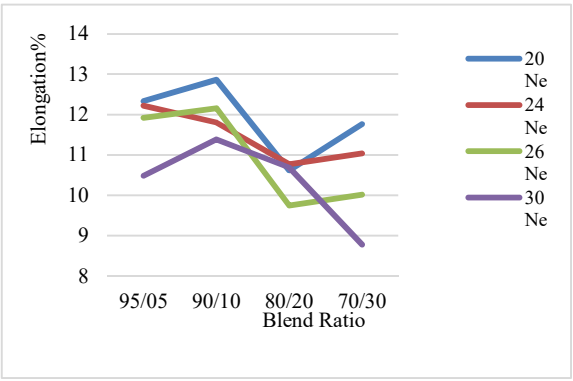
Yarn quality parameters were measured by using Wrap Reel, Uster Tester- 5, Twist Tester, Titan Universal Yarn Testing Equipment and Lea Strength Tester. By maintaining international standards, yarns are tested to get the actual result.

3.1 Effects of blend ratios on single yarn strength and yarn elongation%

Single yarn strength and yarn elongation were tested by Standard-ASTM D2256. The test results are shown in figure 1.



(a)



(b)

Fig. 1. (a) Single yarn strength (b) Elongation% for polyester-flax blend yarns

From figure1, it can be said that, in 95/05 and 90/10 P-F blend ratio shows higher result as compared to other blend ratios. Homogeneous blends were occurred in 95/05 and 90/10 PF blend ratios. Fiber length variation could be the problem to reduce strength. The loss of strength in the blended yarn is attributed to the differences in the breaking elongation of the constituent fibres. This may cause to deteriorate the result for higher percentage of flax fiber is used in P-F blend yarns. So it can be said that, low flax percentage in P-F blend ratio may providing better yarn strength and elongation.

3.2 Effect of blend ratios on Count Strength Product (CSP)

In this research work, bundle yarn strength is expressed as CSP method. The test results of CSP values are shown in figure 2

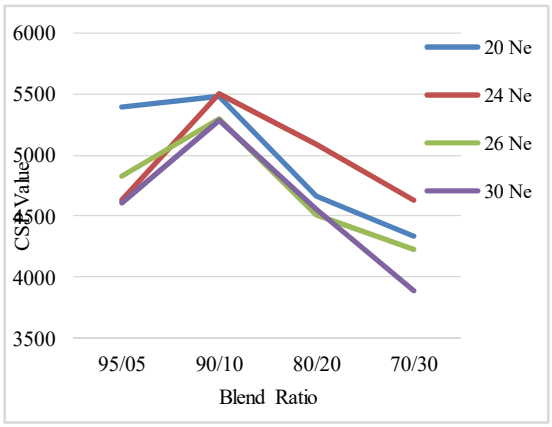


Fig. 2. CSP of different polyester-flax blend yarns

From the figure 2, the values of yarn CSP has been reduced with the increase of flax amount in polyester-flax blends. In this experiment, it can be said that, 90/10 blend ratio is providing better yarn strength. This may be occurred due to homogeneous blending is arranged in 90/10 blend ratio as compared to other blend ratios. After increasing of flax percentage in P-F blend ratio, yarn strength is gradually reduced. So it can be said that, in 90/10 P-F blend ratio may providing better CSP of yarn. By using this said system the spinning mills will be able to produce better quality blend yarn in an economic way [5].

3.3 Effect of blend ratios on yarn unevenness%

The polyester/flax-blended yarns are tested on a laboratory-type machine in standard atmospheric conditions (20±2°C temp. and 65±2% relative humidity), testing speed at 400 m/min using S800 model. The test results are displayed in figure 3

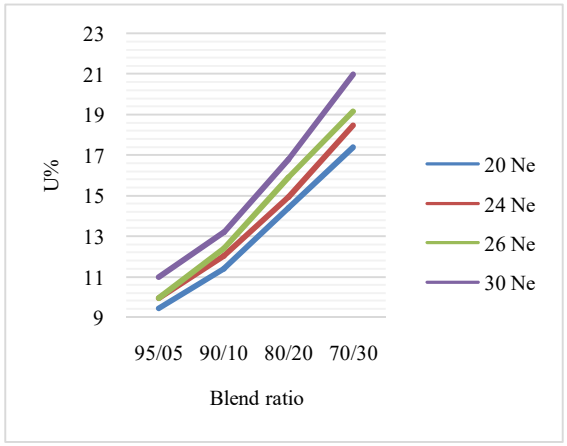


Fig. 3. Yarn unevenness% of different polyester-flax blend yarns.

In figure 3, it is observed that, Unevenness (U %) has gradually increased with the increase of flax fiber content in the yarn. Yarn evenness largely depends on the number of fibers in the yarn cross-section. Also length variation may be the major reasons for yarn unevenness. So it can be said that, if less flax percentage is used in P-F blend ratio may delivering better yarn U%.

3.4 Effect of blend ratios on yarn hairiness

Hairiness, H corresponds to the total length of protruding fibers divided by the length of the sensor of 1 cm. It is also quality parameters of yarn. Testing speed were 400 m/min using the S800 model. The test results are putting in figure 4

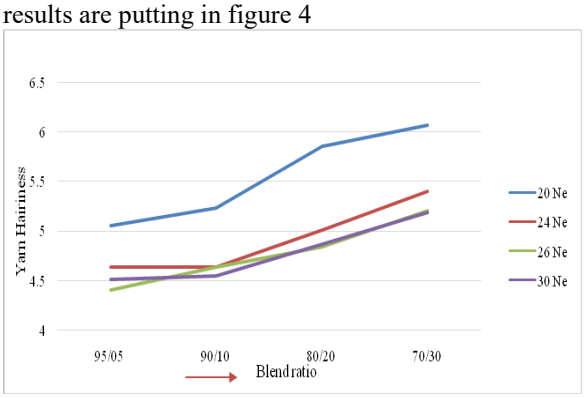


Fig. 4. Hairiness values of different polyester-flax blend yarns

From the figure 4, 95/05 P-F blend ratio showed higher result. These curves gradually rose with the increased of flax amount in polyester- flax blends. This may be due to the variation in profile of two fibers. The diameter of flax fiber is not uniform across its length unlike polyester fiber. Coarser yarns have more hairiness than finer one, because of higher number of fibers in cross-section which leads to higher number of protruding ends of fibers in the yarn surface. So it can be said that, 95/05 blend ratio may showing low level of yarn hairiness.

3.5 Effect of blend ratios on Yarn Imperfections

Yarn imperfections (Thick place +50%, Thin place -40% and Neps +200%) were tested by Uster Tester 5 – S800. From the report, the values are summarized in the figure 5

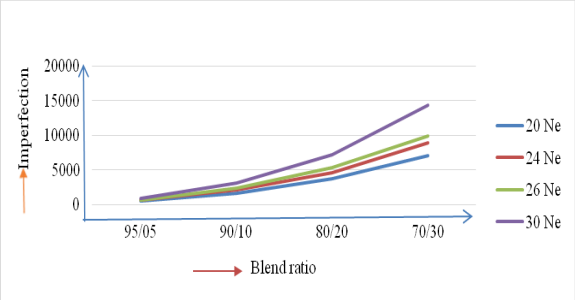


Fig. 5. Yarn imperfections of different polyester-flax blend yarns

In figure 5, it is said that in 95/05 P-F blend ratio, the values of yarn imperfection showed low value and its quality is higher compared to other blend ratio. After increasing flax percentage in P-F blend ratio, the value of imperfection is gradually increased. Short fiber content in flax fiber may be the causes for these results. So it may be said that, if low flax percentage is used in P-F blend ratio, may delivering higher result.

4. CONTRIBUTION

Polyester-flax blended yarn is a new dimension in our textile sector. This research work will motivate to every researcher in this field who want to work successively.

5. CONCLUSION

To conclude, it is clear that with the more percentage of flax in polyester and flax blend ratios yarn irregularities are higher. Polyester is better compatible with lower proportion of flax in their ratios hence exhibits suitable performance. The reason could be the properties of flax which is fixed naturally. Thereafter the high proportion of flax is not compatible with polyester.

6. FUTURE DIRECTION

Blended technology is a new era in our present world. In the thesis work, quality optimization of polyester-flax blended yarn with different ratios was analyzed. In this research work, there were some limitations.
The limitations can be overcome through the future work.

- Increase of machine speed in the processing of polyester-flax blended yarn.
- Production of finer yarn in polyester flax blended yarn.
- Increase of higher percentage of flax fiber in polyester-flax blended yarn.
- Quality optimization of flax and other fibers in different ratios.
- Manufacturing of100% spun flax yarn from flax staple fiber.

7. ACKNOWLEDGMENT

"I write on behalf of myself and all co-authors to confirm that the results reported in the manuscript are original and neither the entire work, nor any of its parts have been previously published. The authors confirm that the article has not been submitted to peer review, nor has been accepted for publishing in another journal. The author(s) confirms that the research in their work is original, and that all the data given in the article are real and authentic. If necessary, the article can be recalled, and errors corrected."

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