ANALYSIS OF QUALITY PARAMETERS OF BLENDED AND "SIRO" YARNS

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Abstract

This study evaluates the quality characteristics of yarns made from fiber blends and those spun using the "Siro" ring-spinning technique. Three yarn types were compared: cotton/polyester (50/50) blend, cotton/viscose (50/50) blend, and a cotton/polyester (50/50) "Siro" yarn. The results show that the linear unevenness (U%) of the "Siro" yarn and the cotton/viscose blend is better than that of the conventional cotton/polyester blend. Thin places (−50%) in the "Siro" yarn were 75% fewer than in the regular blend, whereas thick places (+50%) were 25% more frequent compared to the cotton/polyester blend. Although the specific breaking strength of the "Siro" yarn is up to 50% higher than that of the blended yarns, its coefficient of variation (CV%) does not differ dramatically. However, the "Siro" yarn exhibits significantly lower hairiness and fewer neps. The cotton/polyester "Siro" yarn stands out for its high specific breaking load, low fuzziness, low nep count, and a smooth, strong structure. These findings provide a scientific basis for selecting fiber mixtures and the "Siro" spinning technology in textile manufacturing.

Keywords

blended yarn, cotton, polyester, viscose, Siro spinning, unevenness, yarn quality.

INTRODUCTION

In August 2025, the President of the Republic of Uzbekistan emphasized the need to launch projects producing at least 100 thousand tons of blended fabrics by year's end. This reflects a global trend: due to limited natural fibers (cotton, wool,

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flax) and rising living standards, chemical fibers are gaining ground. In 1995, natural fibers accounted for at least 55% of the market; by 2028, forecasts suggest they will fall below 30% [1].

Modern chemical fibers increasingly match natural ones in hygiene and comfort while offering elasticity, high strength, deformation resistance, and tolerance to high temperatures and aggressive chemicals. Production is season-independent, requires less labor (though technologically complex), and allows precise parameter control—key advantages over natural fibers. The properties of a blended yarn directly influence fabric strength, moisture absorption, thermal insulation, and other features. Blended yarns are produced via ring, vortex, and aerodynamic spinning, and ongoing research explores blending theory and yarn behavior [2].

THEORETICAL BACKGROUND

Polyester-cotton blends are widely used in apparel manufacturing. Polyester alone is also in high demand. In ring spinning, cotton remains the predominant raw material, but cotton waste, synthetic fibers (polyester, acrylic, polyamide, polypropylene), and various blends (cotton/synthetic or synthetic/artificial) are also employed. Recently, blends of polyester, bamboo, modal, and cotton have gained popularity [3, 4, 5].

Studies on 19.6 tex ring-spun yarns with polyester/cotton ratios of 50/50, 60/40, 70/30, and 100% showed that increasing the polyester fraction improves yarn tenacity, elongation at break, and reduces unevenness and nep count [6]. Indian researchers T. Vadicherla and D. Saravanan investigated 23.6, 29.5, and 39.4 tex ring-spun yarns from five blend ratios (0:100, 33:67, 50:50, 67:33, 100:0 polyester/cotton). Higher polyester content increased strength and elongation while decreasing hairiness, unevenness, and neps [7].

Bamboo/polyester blends offer unique advantages: bamboo fibers are antibacterial, moisture-absorbing, deodorizing, and heat-retaining; polyester adds high strength, elastic recovery, durability, wrinkle resistance, easy ironing, quick drying, and minimal strength loss when wet [8].

Blending different fibers can improve yarn unevenness and mechanical properties. The blend ratio also affects fabric strength, hygroscopicity, and thermal insulation [9]. Yarn breakage occurs either by fiber rupture or slippage; rupture depends on fiber core strength and fiber distribution across the cross-section, while slippage is influenced by twist [7]. For an 80/20 cotton/polyester blend, twist levels between 850 and 918 t/m reduced unevenness CV% and increased specific breaking load, breaking force, and work of rupture [10].

Fabrics made from cotton-polyester yarns provide adequate warmth, softness, and comfort, while allowing skin to breathe—provided the blend ratio is properly chosen [11]. Regression equations have been developed to optimize blend percentages for maximal specific breaking load and elongation, with tests confirming process repeatability and adequacy [12].

Given the variety of fibers and spinning systems, improving yarn properties through blending is a key contemporary task. Producing modern textile assortments from such blends is a high priority. For multi-component "Siro" yarns, identifying factors that affect intermediate products and final yarn properties, and determining optimal process parameters, are crucial [13].

EXPERIMENTAL WORK

Experiments on multi-component "Siro" yarns were conducted at OSBORN TEXTILE LLC using Zinser-350 ring spinning frames equipped with an Amsler attachment. The technological line for cotton roving preparation is shown in Table 1.

Table 1. Technological line of machines at the enterprise

N	Machine name	Model
1	Automatic bale opener	BDT-019
2	Blending opener	BL-TO
3	Preliminary cleaner	AFC 015
4	Mixing machine	MSM 8/1600
5	Main cleaner	CVT 3
6	Aerodynamic cleaner	DX 385
7	Carding machine (flat)	DK 803
8	Draw frame (1st passage)	RIETER SB-D 50
9	Draw frame (2nd passage)	RIETER RSB-D 50
10	Roving frame	ZINSER-670
11	Ring spinning frame	ZINSER-350
12	Winding machine	QPRO EX

Cotton used: 60% of selection "Sultan" (type 4, grade I) and 40% of selection "Bukhara-6" (type 4, grade I). Polyester roving was made from 100% polyester fiber. Physical-mechanical properties of cotton (UzDST-604-2016) and polyester (GOST 25716-94) are given in Tables 2 and 3.

Table 2. Physical-mechanical properties of blended cotton fibers

Type	Selection	Micronaire	Staple length (32nds, code)	Upper mean length :100)	Specific strength (gf/tex)	Uniformity (%)	Rd (%)	+b (%)	Elongation (%)	Leaf code	Short fiber index (%)
4	Osborn n	5.05	35	110	33.1	83.1	80.3	8.5	6.3	4	6.3
4	Osb. ara-6	4.65	37	117	35.0	83.5	76.5	9.6	5.2	2	5.8

Table 3. Physical-mechanical properties of polyester fiber

Parameter	Value
Linear density (mtex)	133
Breaking force (cN)	6.15
Staple length (mm)	38
Elongation at break (%)	22.5
Complex fibers variation (%)	0.08
Uncut fibers variation (%)	0.07
Crimps per 1 cm (count)	13
Specific strength (cN/tex)	40

The aim was to develop new raw material assortments for outerwear fabrics. Three Ne 30/1 yarns were prepared: cotton/polyester (50/50), cotton/viscose (50/50), and “Siro”-spun cotton/polyester (50/50). A brief spinning plan for the “Siro” yarn is shown in Table 4. Quality indicators measured with Uster TESTER-6, Uster TENSORAPID-5, etc., are compiled in Table 5.

Table 4. Spinning plan for Ne 30/1 cotton/polyester (50/50) “Siro” yarn at Osborn Textile LLC

N	Machine / stage	Output linear ty	Doubling (d)	Draft (E)	Twist factor >T</sub>	Twist (t/m)	Delivery speed n)	Spindle speed (rpm)	FVK	Theoretical output
Cotton										
1	Carding	5369	–	–	–	–	120	–	0.97	38
2	Draw frame I	4922	6	6.54	–	–	700	–	0.95	196
3	Draw frame II	4375	6	6.75	–	–	650	–	0.90	153

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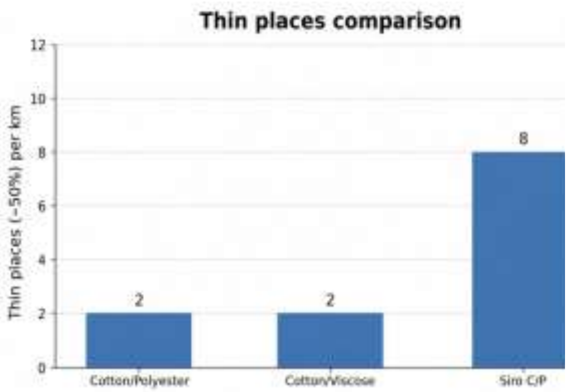
4	Roving	492	1	9.33	1.5	65	20	1300	0.85	60
Polyester										
1	Carding	5369	–	–	–	–	120	–	0.97	38
2	Draw frame I	4922	6	6.54	–	–	700	–	0.95	196
3	Draw frame II	4375	6	6.75	–	–	650	–	0.90	153
4	Roving	492	1	9.33	1.0	43	31.4	1350	0.87	96
5	Spinning (Ne 30/1)	30/1	20×1	52.5	3.61	780	19.2	1500	0.95	16.5

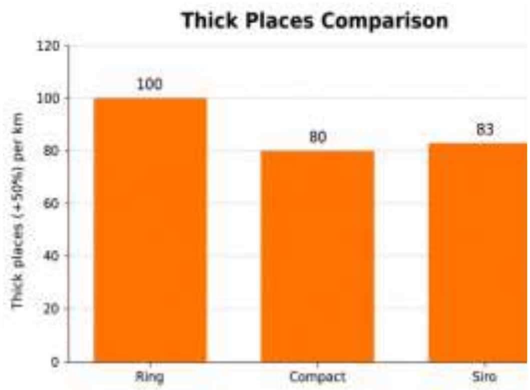
Table 5. Properties of blended and "Siro" yarns

Parameter	Unit	Blended yarns	"Siro" yarn	
		Cotton/polyester (50/50)	Cotton/viscose (50/50)	Cotton/polyester (50/50)
Linear density (Ne)	–	30/1	30/1	30/1
Unevenness (U%)	%	0.97	0.93	0.93
CV (Ne)	%	0.9	1.05	0.91
Twist (t/m)	t/m	750	850	786
CV (twist)	%	0.97	0.93	0.93
Thin places (−50%)	/km	2	2	8
Thick places (+50%)	/km	100	80	83
Neps (+200%)	/km	175	130	77
Hairiness (H)	–	6.15	5.9	5.73
Specific breaking strength (Rkm)	cN/tex	18.8	13.3	22.37
CV (Rkm)	%	7.5	6.8	7.58
Elongation at break (Elong.)	%	8.1	5.0	7.42

RESULTS AND DISCUSSION

Thin and thick places – Figure 1a shows that the highest number of thin places (−50%) occurred in the "Siro" yarn (8/km), while both conventional blends had only 2/km. For thick places (+50%, Fig. 1b), the cotton/polyester blend had 100/km, cotton/viscose 80/km, and the "Siro" yarn 83/km. Thus, the "Siro" yarn was intermediate for thick places but worse for thin places.

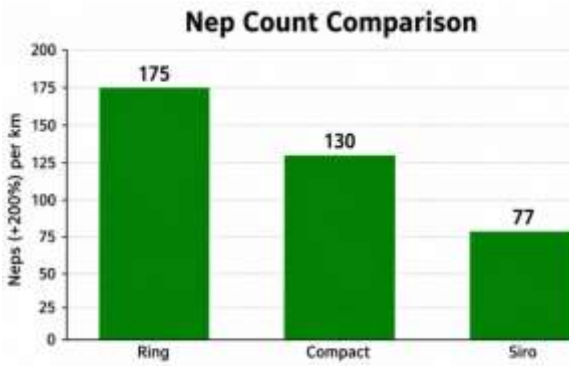




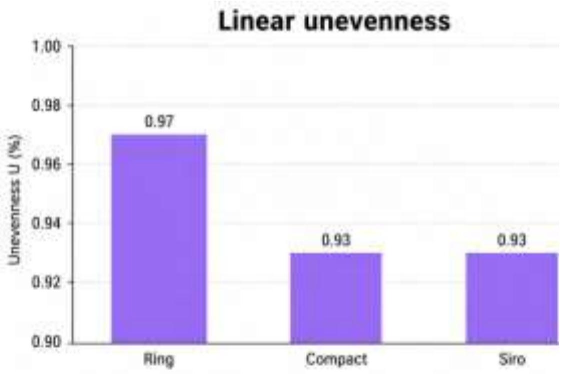
a b

Figure 1. a) Thin places (−50%) per km; b) – Thick places (+50%) per km.

Neps and unevenness – Neps (+200%, Fig. 2a) decreased from 175/km (cotton/polyester) to 130/km (cotton/viscose) and further to 77/km ("Siro" yarn). Linear unevenness U% (Fig. 2b) was identical (0.93%) for cotton/viscose and the "Siro" yarn, while the cotton/polyester blend had 0.97%.



a)



b)

Figure 3. a) – Neps (+200%) per km; b) – Linear unevenness U%

The higher unevenness in cotton-rich blends is explained by the inherent variability of cotton fibers (dead fibers, trash, neps) that is amplified during cleaning, opening, and mixing. Chemical fibers, being more uniform in fineness and length, improve unevenness indices when their proportion increases.

CONCLUSION

The study compared three Ne 30/1 yarns: conventional cotton/polyester and cotton/viscose blends, and a "Siro"-spun cotton/polyester blend. The "Siro" yarn demonstrated the highest specific breaking strength (22.37 cN/tex), the lowest hairiness (5.73), and the fewest neps (77/km). Its elongation at break (7.42%) was second only to the conventional cotton/polyester yarn. Unevenness (U%) was better for the "Siro" and cotton/viscose yarns (0.93%) than for cotton/polyester (0.97%). However, the "Siro" yarn had more thin places (−50%) but fewer thick places than the cotton/polyester blend. These results provide a solid foundation for choosing blend compositions and "Siro" technology in industrial textile production.

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