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Evaluation of Physical Properties of Core Spun Yarn through Variation of Core Numbers

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ABSTRACT

The core-spun yarn has gained much concern and popularity all over the world for having elastic and comfort properties. Draft ratio of the core, the number of cores and the type of sheath material are the prime parameters of producing core-spun yarn. These parameters influence the physical and mechanical properties of the yarn. In this study, the effect of the number of core-spun yarn cores was investigated on the yarn's physical and mechanical properties. Two types of core-spun yarn were produced: single core-spun yarn and dual core-spun yarn. Cotton fibres were used as a sheath, spandex monofilament and polyester multi-filament were used in the core. It was revealed that dual core-spun exhibits lower unevenness, imperfection and hairiness value than single core-spun yarn. In addition, bundle strength of yarn was found higher in dual core-spun yarn.

1. INTRODUCTION

Elasticity is one of the most important parameters in clothes that influence comfort and mobility. Comfort is a garment facility that permits the easy movement of different body parts as the garments have stretch and recovery properties like retention of the previous shape without any deformation. Spandex is a synthetic filament that contains at least 85% by weight of segmented polyurethane in its long-chain synthetic elastomer, which is regarded as the fiber-forming component[15]. Elastane was produced using a variety of manufacturing techniques, including dry spinning, wet spinning, and melt spinning, with varying tensile characteristics and cross-sectional geometries[1-3]. There are several significant aspects of composite yarns that include a spandex core and are coated in other staple fibers. These yarns have the same feel as some kinds of outer fibers and have high moisture absorption[4, 5]. There are several manufacturers of spandex in the globe, and the marketplaces provide a variety of brands, types, and prices of spandex fibers[6-7]. Also used to blend spandex with other textile fibers are the spinning processes of core, cover, air entangling, and Siro[7-11]. The core-spun yarn contains elastane in the core, providing stretch and recovery properties to the fabric without any excessive deformation. The physical and mechanical properties of core-spun yarn depend on different core filaments, the number of core filaments and sheath fibres. Core-spun yarn is produced in a ring frame containing a special guiding attachment and elastane feeding rollers.
To improve the quality of core-spun yarn, many studies performed in this segment are available in the literature. Baghaei et al. [12] conducted a study to investigate the increase in the draw ratio of elastane core led to an increase in elastic recovery of woven stretch fabrics. Another study investigated that while increasing the draw ratio of elastane core in core-spun yarn, During the tear strength and recovery after the stretch drop, the fabric's tensile strength and stretchability rise. Mourad M. [13] investigated that the change in elastane draft ratio has a vital effect on fabric's physical and tensile properties from core-spun yarn[14]. Previous studies investigated the effects of elastane draw ratio in core-spun yarn on fabric's physical and mechanical properties. But there is still a need for more investigation in this segment. The current work aimed to investigate the effect of

the number of core-spun yarn cores on the yarn's physical and mechanical properties.

2. MATERIALS AND METHODS

This study is intended to investigate the effects of the number of core-spun yarn cores. Within the scope of this study, 16Ne and 20Ne English count of single and dual core-spun yarn was produced. First, the single core-spun yarn was produced by cotton and spandex filament. Here cotton is used as sheath material, and spandex is placed in the core. Next, polyester filament and spandex were placed in the core to produce dual-core yarn. The properties of the cotton fibre and core components of elastic dual core-spun yarns are given in Table 1.

Table 1: Fiber and filament characteristics.

Characteristics	Values		
	Cotton	Elastane(spandex)	Polyester filament
Fineness (mic)/ Linear density (Den)	4.2Mic	40Den	75Den
Strength (g/tex)	28	10	45
Elongation (%)	7.02	551	24
Spinning Consistency Index	121	-	-
Length (mm)	28	-	-

16Ne cotton card ring spun yarn samples were produced with a single core and dual core. The cotton fibre sample was tested on HVI, and the yarn properties were tested on Uster Tester 5 and Uster Tensorapid. Parameters for producing 16Ne single core and dual core-spun yarn are given in Table 2.

Table 2

Ring frame parameters	16/1Ne		20/1Ne	
	single core-spun yarn	dual core-spun yarn	single core-spun yarn	dual core-spun yarn
Elastane Denier	40D	40D	40D	40D
Elastane draw ratio	3.50	3.50	3.5	3.5
Polyester Filament Denier	-	75D		75
Filament draw ratio	-	1.08		1.08
TM	4.9	4.9		4.9
TPI	19.60	19.60	21.91	21.91
Spindle Speed	10500	10500	11000	11000

3. RESULTS AND DISCUSSION

A summary of the results of yarn testing depicting the effect of the number of cores of core-spun yarn is given in Table 3.

Table 3: Yarn quality reports.

Yarn Quality Parameters	16/1Ne		20Ne	
	Single Core-Spun Yarn	Dual Core-Spun Yarn	single core-spun yarn	dual core-spun yarn
U%	10.84	8.95	11.55	10.12
IPI	95	71	117	135
H	7.25	7.05	7.09	6.91
CSP	2035	2175	2095	2201

3.1 Yarn Unevenness (U %)

The variation of yarn unevenness against the number of the core of core-spun was plotted in figure 1. It was detected that the number of cores profoundly influences yarn unevenness. Single-core spun yarn is more uneven than dual core spun yarn. This results from fewer fibers being wrapped around the core as the number of cores increases.

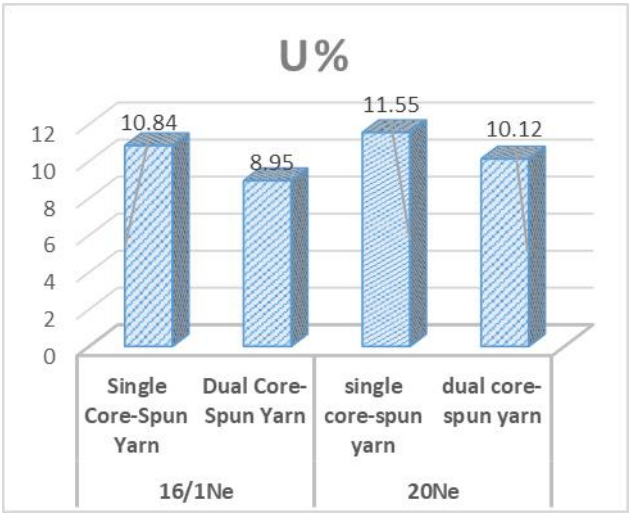

Figure-1: Effect of number of core on U%

3.2 Imperfection Index (IPI)

The variation of yarn imperfections against the number of the core of core-spun was plotted in figure 2. It was shown that the amount of cores had a significant impact on yarn flaws. Single-core spun yarn has more flaws than dual core spun yarn. This results from fewer fibers being wrapped around the core as the number of cores increases. However, the short cotton fibers present caused the defects to be created.

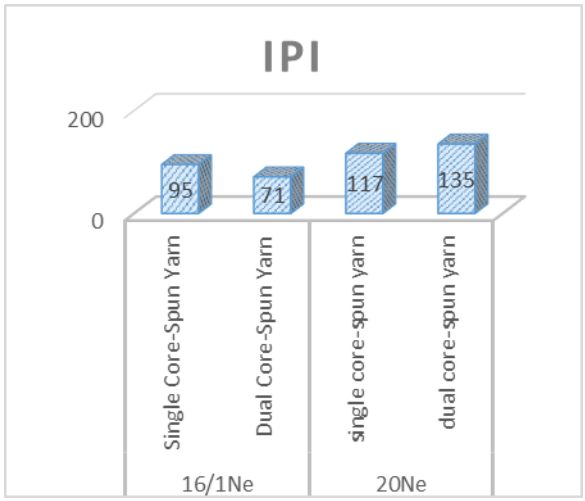

Figure 2: Effect of number of cores on IPI

3.3 Hairiness (H)

The variation of yarn hairiness against the number of the core of core-spun was plotted in figure 3. It was shown that yarn hairiness is influenced by the number of the core. The hairiness of dual-core spun yarn is lower than that of single-core spun yarn. This results from fewer fibers being wrapped around the core as the number of cores increases. Short cotton fibers were present, which resulted in the development of hairiness.

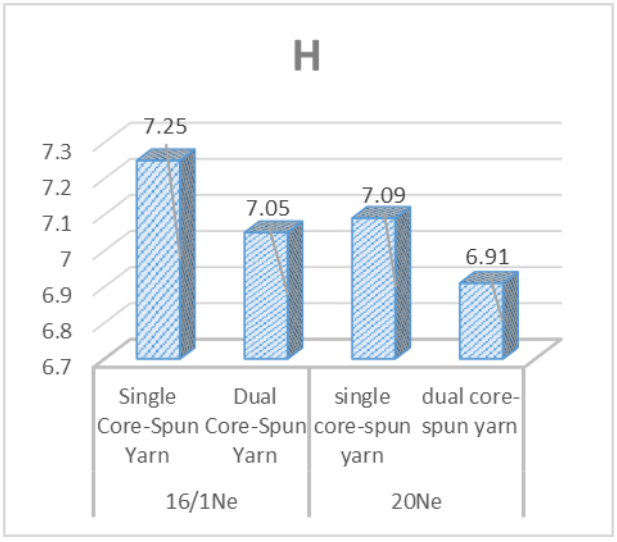

Figure 3: Effect of number of cores on Hairiness

3.4 Bundle Yarn Strength (CSP)

The variation of yarn strength against the number of the core of core-spun was plotted in figure 4. It was observed that the number of the core influences yarn strength. Dual core-spun yarn shows higher strength than single-core spun yarn. This is due to the polyester filament in the yarn's core.

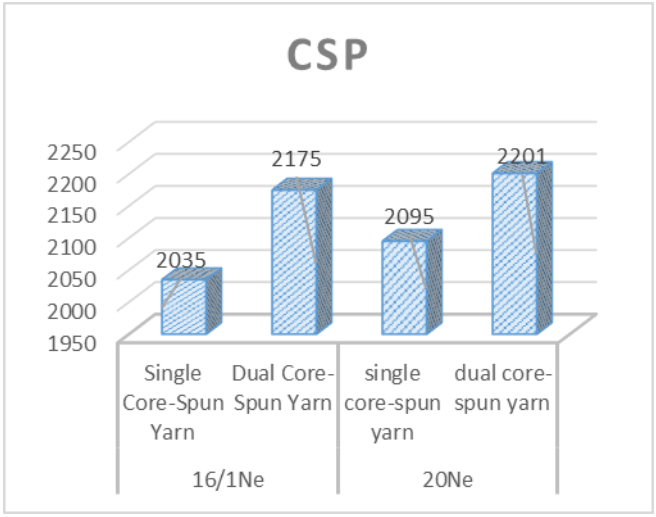

Figure 4: Effect of number of core on CSP

4. CONCLUSION

Due to their elastic and comfortable qualities, composite yarns with spandex have earned a lot of attention and appeal during the last 20 years. The number of cores, sheath type, and core draft ratio are the primary variables influencing these yarns' characteristics. In this research, a comparison of the physical characteristics of single-core and dual-core yarn was done. The strength, unevenness, flaws, and hairiness of core-spun yarn are all strongly positively correlated with the number of cores in the yarn. The authors will analyze the impact of core count on the mechanical and physical characteristics of woven fabric in further work.

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