

An investigation on the variation of woven fabric properties made from regular ring spun, compact & SIRO spun yarn.

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ABSTRACT

Woven fabric properties are greatly dependent on yarn properties especially on yarn structures. Object of this paper is to show the variations of the woven fabric properties made from different structured yarns. Three different types of yarns – regular ring spun, compact & SIRO spun yarn were used to produce 1/1 plain woven fabric to study the recommended properties- tensile strength, tearing strength, abrasion resistance, pilling resistance and dye absorbency. The yarns were made from 100% cotton with combing process and the fabrics with construction of 24X24/90X60, 20”. According to results, the structural differences of ring, compact and SIRO spun yarns have significant influence on the fabric properties. Fabrics woven from compact yarns were found to have better tensile strength, tearing strength and pilling resistances than fabrics woven from regular ring spun and SIRO spun yarn. Fabric made from compact yarn found to have poorer abrasion resistance compared to other fabrics. In case of dye absorbency fabrics made from SIRO spun yarn were found to have better results. The results were very significant and will surely help the woven fabric manufacturers to choose the exact type of yarn for their recommended fabric properties.

Keywords: Regular ring yarn, compact yarn, SIRO yarn, woven fabric, physical properties.

1. Introduction:

Properties of spun yarns are mainly affected by fiber properties and yarn structure. Yarn structure is principally influenced by the spinning system. In fact, each spinning system tends to produce a distinctive yarn structure. Recent refinements in spinning technologies have yielded significant improvement in yarn structure. Siro and compact spinning are the new spinning systems to have made a breakthrough until recently.

All these three types of yarns are produced by ring spinning system i.e yarn is produced by ring machine. The basic difference among their production process are as below: the compact yarn is produced by the same technique as the conventional ring spun yarn but have an extra compacting zone that is equipped by the suction system. In this zone, maximum free & protruding fibers become parallel & condensed. Immediately after this condensing zone, this fibrous bundle is twisted in normal & conventional style. When two parallel fiber strands, separated at a distance, are drafted simultaneously in the drafting zone and after they emerged from the front roller nip, they converge to form a yarn by twisting. And that yarn is called “SIRO” yarn. SIRO spun yarns are produced on a conventional ring frame. The process was invented around 1975-76 by the laboratories of the Commonwealth Scientific International Research Organisation (CSIRO) Division of Textile industry in Australia.

Woven fabric has several important properties. Among them the following physical and mechanical properties were studied because yarn structure affects them mostly. The intended properties are as follows:

(a) Tensile strength: The tensile strength of a textile is the maximum amount of tensile stress that it can take before failure. (b) Tearing strength: It is the applied load which is used not to initiate a tear but to propagate an existing tear. (c) Abrasion resistance: Abrasion is just one aspect of wear & is the rubbing away of the component fibers & yarns of the fabric. (d) Pilling resistance: Pilling is the surface fault of woven fabrics which is recognized by the clear appearance of pills. (e) Dye absorbency: Dye absorbency of a fabric means the capacity of fabrics to accept dyes.

2. Literature Cited:

Sunay Omeroglu, and Sukriye Ulku works on Tensile Strength, Pilling and Abrasion Properties of Woven Fabrics Made from Conventional and Compact Ring-Spun Yarns and they found Fabrics woven from compact yarns were found to have higher tensile strength and pilling and abrasion resistances than fabrics woven from ring yarns[1]. Alsaid. A. Almetwally and Mona. M. Salem works on “Comparison Between Mechanical Properties of Fabrics Woven From Compact & Ring spun Yarns” and they found that there is no significant difference between both type of fabrics regarding tearing strength and abrasion resistance. But in relation to tensile strength, air permeability and stiffness, compact fabrics were superior to ring fabrics[2]. BI Song-mei works on The application, development and economical analysis of SIRO spun. The SIRO spun principle, technological requirements, processing equipment, product specialties and

processing program are described by him in his paper detail [3]. Zhang Changle works on SIRO spinning, the similarities and the differences of the structure and the performance among SIRO yarn, single yarn and plied yarn. By his experiment he found that The SIRO yarn has a few hairiness, good abrasion resistance, short production processing and can obtain a good economic benefit [4] Chen Yixing works on The Properties and Structure of SIRO spun Yarn. The effects were investigated of various parameters of a modified spinning frame for SIRO spun on the yarn properties with a 2~4-factors method. A comparison of the properties was made between two-fold yarn, SIRO spun yarn and single yarn, and it was proposed that some recommended parameters might contribute to the performance improvement of cotton SIRO spun yarn. The amount of strand-twist and the structure feature of SIRO spun yarn was described [5] Kirecci Ali , Kaynak Hatice Kubra , Ince Mehmet Erdem works on Comparative Study of the Quality Parameters of Knitted Fabrics Produced from SIRO spun, Single and Two-ply Yarns twist multiplier on the properties. They found that , the spirality values of plied yarn fabrics are slightly lower than those of SIRO spun yarn fabrics at finer yarn count values. These results indicate that SIRO spun yarn may be a good alternative for plied yarn due to its extremely low production cost and high quality values [6].

3. Experimental Setup:

Yarn Sample: 100% cotton combed yarn of count 24^sNe. The yarn specification is as below:

Table 1: Yarn Specification

Specification	Ring	Compact	SIRO
Actual count	23.53	23.59	23.67
CV%	0.66	.69	0.77
IPI	28.00	40.1	47.9
CSP	2856	3228	3038
E%	8.93	8.67	8.77
TPI	17.54	17.54	17.54
Fiber MIC Value	4.57	4.57	4.57
Fiber Staple Length(mm)	28.26	28.26	28.26
Type	Comb	Comb	Comb

Fabrics Sample: All the fabrics were made with the following constructions- 90X60/24X24, 20",1/1 plain weave. The testing procedures and testing methods are as below:

Table 2: Fabric testing methods

Sl no	Name of the Test	Sample Size	Test Standard
1	Tensile Strength	6inch × 4inch	ISO 13934-2-2014 Textiles
2	Tearing Strength	7.5cm × 10cm	ASTM D1424-09(2013)
3	Abrasion Resistance	38mm(Diameter)	ISO 12947-1-1998 Textiles
4	Pilling Resistance	140mm(Diameter)	ISO 12945-2-2000 Textiles
5	Dye Absorbency	4cm × 1cm	AATCC Test Method 79

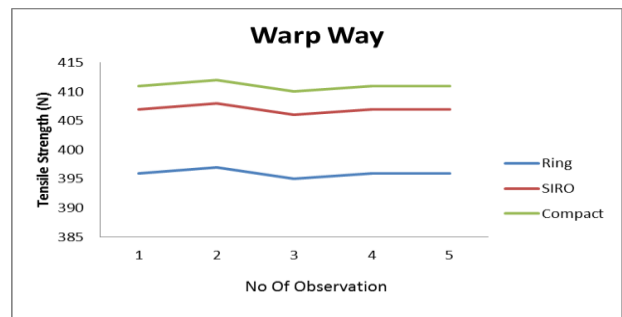
4. Results & Analysis:

4.1 Results:

Table 3: Tensile Strength

No of observation	Warp Way			Weft Way		
	Ring	SIRO	Compact	Ring	SIRO	Compact
1	396	407	411	263	229	278.4
2	397	408	412	264	228	278
3	395	406	410	262	230	277.6
4	396	407	411	263	229	278.3
5	396	407	411	263	229	279.3

Graphical Representation:



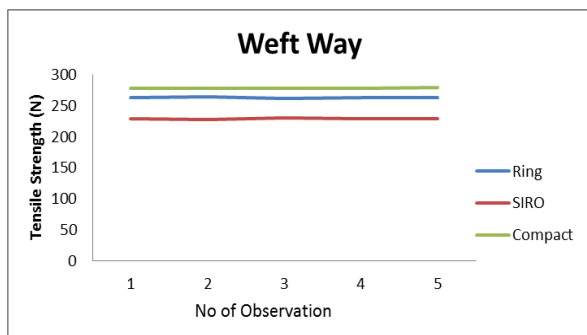


Table 4 : Tearing Strength:

No of Observation	Warp Way			Weft Way		
	Ring Spun	Compact	SIRO	Ring Spun	Compact	SIRO
1	16.07	16.0	15.01	12.51	13.19	13.41
2	16.3	17.0	15.07	13.03	12.19	12.41
3	15.9	15.0	15.05	11.99	14.19	14.41
4	16.01	16.0	14.9	12.51	13.25	13.31
5	16.05	16.0	15.01	12.51	13.13	13.51

Graphical Representation:

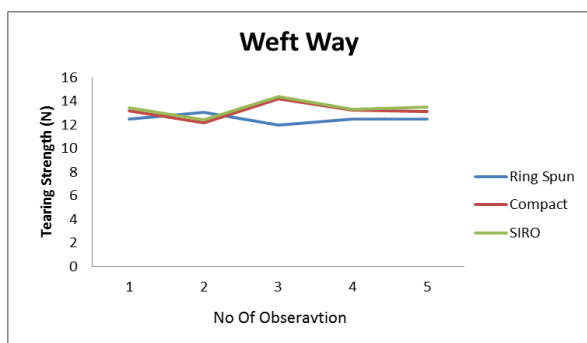
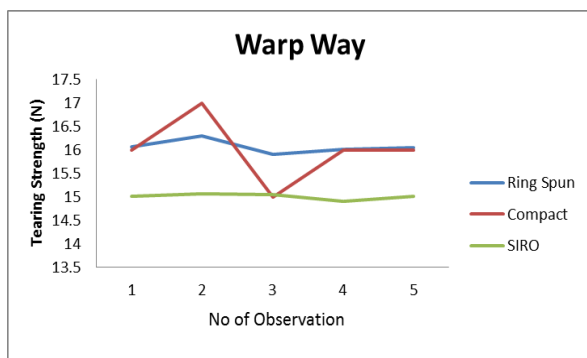


Table 5: Abrasion Resistance:

Yarn Type	Weave and construction	Revolution	Grade	Result
Ring spun	1/1 Plain 24×24/90×60	10000	3-4	No yarn were broken
Com Pact			3	Two or more yarn were broken
SIRO			3-4	No yarn were broken

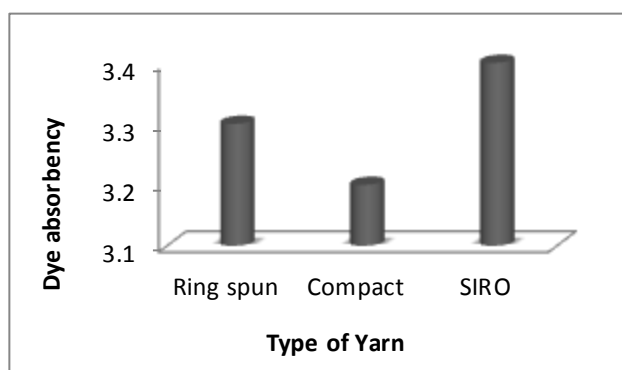
Table 6: Pilling Resistance:

Yarn Type	Weave and construction	Revolution	Grade	Comment
Ring spun	1/1 Plain 24×24/90×60	2000	2-3	Moderate surface pilling
Com Pact			4	Slight surface fuzzing
SIRO			2-3	Moderate surface pilling

Table 7: Dye Absorbency

Yarn Type	Weave and Construction	Result (Dye absorbency)
Ring Spun	1/1 Plain 24×24/90×60	3.3
Compact		3.2
SIRO		3.4

Graphical representation:



4.2 Analysis:

1. Tensile Strength:

Warp way (avg):

Compact(411N)>SIRO(407N)>Ring spun(407N)

Weft way (avg):

Compact(278N)>Ring spun(263N)>SIRO(229N)

2. Tearing Strength:

Warp way (avg):

Ring spun(16.07N)>Compact(16N)>SIRO(15.01N)

Weft way (avg):

SIRO(13.41N)>Compact(13.19N)>Ring spun(12.51N)

3. Abrasion Resistance:

Ring spun and SIRO(3-4)>Compact(3)

4. Pilling Resistance:

Compact(4)>Ring spun and SIRO(2-3)

5. Dye Absorbency:

SIRO(3.4)>Ring spun(3.3)>Compact(3.2)

4.3 Discussion:

The tensile strength, pilling and tearing strength of the fabrics woven from compact, ring and SIRO yarns were investigated. Compact yarns have better fibre orientation than ring yarns and SIRO yarns, which results in better yarn properties and performance improvements in woven fabrics, especially those made from compact yarns.

In case of abrasion resistance no significant differences were obtained. Slightly higher abrasion resistance in fabric made from ring spun and SIRO yarn. The reason for this may be the possibility that the breakage of any yarn on the fabric's surface is high after a certain level of abrasion.

In case of dye absorbency fabric made from SIRO yarn has better dye absorbency and then ring spun yarn due to their fluffy structure and comparatively low dye absorbency of fabric made from compact yarn due to their compact structure.

5. Conclusion:

By this work, it was tried to show that different yarns have a significant influence on most physical & mechanical properties of woven fabric. It is proved that fabric made from ring spun, compact and SIRO yarn differ significantly regarding fabric properties. Finally it

can be concluded that fabrics made from compact yarn have better physical & mechanical properties.

REFERENCES

- [1]. Sunay Omeroglu, Sukriye Ulku . An investigation about tensile strength, pilling and abrasion properties of woven fabrics made from conventional and compact ring-spun yarns, *FIBRES & TEXTILES in Eastern Europe* 2007
- [2] . Alsaïd. A. Almetwally and Mona. M. Salem, Comparison between mechanical properties of fabrics woven from compact and ring spun yarns, *AUTEX Research Journal*, Vol. 10, No1, March 2010
- [3]. BI Song-mei, The application, development and economical analysis of SIRO spun yarn, *Journal of Anhui Institute of Mechanical and Electrical Engineering*; 2000-03
- [4]. Zhang Changle The Spinning Principle and the Product Development of SIRO Spinning. *Journal of Textile Research* 1986-09.
- [5] Chen Yixing The Properties and Structure of Siro Spun Yarn[J]; *Journal of Textile Research*; 1986-09.
- [6] Kireççi A., Kaynak H. K., Ince M. E.; Comparative Study of the Quality Parameters of Knitted Fabrics Produced from Sirospun, Single and Two-ply Yarns. *FIBRES & TEXTILES in Eastern Europe* 2011, Vol. 19, No. 5 (88).
- [7] Yang Rui-Hua, Xue Yuan, Wang Shan-Yuan; Comparison and Analysis of Rotor-Spun Composite Yarns and Sirofil Yarn. *FIBRES & TEXTILES in Eastern Europe* 2010, Vol. 18, No. 1 (78).
- [8] Soltani P, Johari MS. Effect of Using the New Solo-siro Spun Process on Structural and Mechanical Properties of Yarns. *FIBRES & TEXTILES in Eastern Europe* 2013; 21, 3(99)
- [9] Beceren Y., Candan C., Cimilli S., Ülger K.; Properties of Plain Knits from Siro-SpunViscose/Spandex Yarns. *FIBRES & TEXTILES in Eastern Europe* 2010, Vol. 18, No. 1 (78)
- [10] *Principal of Textile Testing*. - J.E. BOOTH
- [11] *Physical testing of textiles*. - B P Saville
- [12] *Manual of Textile Technology*. - W. Klein