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RETROFITTING OF SIMPLE MECHANICAL COMPACTING DEVICE (ROCOS) ON CONVENTIONAL RING SPINNING MACHINE FOR IMPROVING YARN QUALITY

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Abstract

Ring spinning is the most popular and universal spinning system due to its significant advantages in comparison with the new spinning systems. But the yarn properties are hampered in ring spinning system with the increase of spindle speed and spinning triangle. Overall yarn properties can be improved by retrofitting of simple mechanical device (rocos) on conventional ring spinning machine. In this study we try to show, how rocos overcome the negative influences of spinning triangle on yarn quality. It also ensures outstanding yarn properties such as hairiness, strength, imperfections, elongation etc. Inspite of higher spindle speed as compared to the yarns which are produced in conventional ring spinning machine by using same raw materials.

Keywords: Retrofit, spinning triangle, rocos, imperfections, hairiness

Introduction

There are different spinning systems are available to convert the different textile fibers into yarn such as ring, rotor, siro, compact, friction, air-jet etc.among them ring spinning is the most useable and popular. The spinning triangle is the most troublesome and weakest zone in the yarn formation process in ring spinning as it increases end breakage, fiber loss and yarn hairiness (Murugan, R. & Vigneswaran. 2011, 211). In order to obtain fundamental improvements in ring spinning, the modification of the ring machine is necessary. Compact spinning aims at eliminating the spinning triangle and the problems associated with it (jaswant rajaney,2008,8).the introduction of compact spinning has minimized the negative influence of the spinning triangle in ring spinning (Murugan, R & Vigneswaran 2011, 211). The compaction of the fibers can be accomplished either by using mechanical condenser or pneumatic condenser (Rocos-magnetic). The condensing of the strand of fibers is brought about by air suction. The power required to produce this suction is substantial, the pneumatic compacting devices are expensive, and may require elaborate maintenance. Rocos, the rotorcraft compact spinning system, works without air suction and uses magnetic mechanical principles only. Besides the adaption of pneumatic compacting system in the conventional ring spinning machine is not easy and expensive. In this study we use mechanical condenser of rocos mechanical compact spinning of rotorcraft company because rocos device can be easily retrofitted with the conventional ring spinning machine.

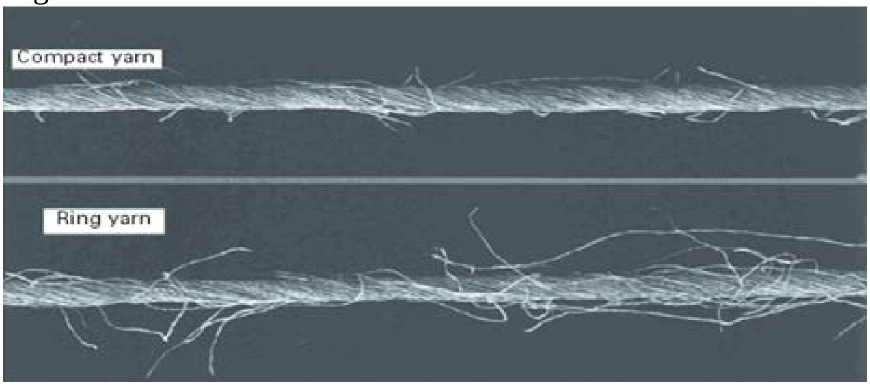

Figure 1: Yarn structure of compact yarn and conventional ring spun yarn (microscopic view) (Lawrence, 2010, 240).

Spinning triangle

In the ring spinning frame the fiber bundle follows a path between the drafting system and yarn take-up on the cop. This path involves the drafting arrangement, thread guide, balloon control ring, and traveler. These elements are arranged at various angles and distances relative to each other. All these distances, inclinations and angles are referred to as the spinning geometry. The spinning geometry has a significant effect on the end breaks, tension conditions, and generation of fly, yarn hairiness and yarn structure.

Twist is imparted by the traveler and goes up as close as possible to the nip line of the front rollers. However, twist never penetrates completely to the nip line. Since the width of the fiber bundle emerging from the drafting system is many times the diameter of the yarn to be spun, fibers in the bundle have to be diverted inwards and wrapped around each other. Consequently, at the exit from the front rollers there is always a triangular bundle of the fibers without twist which is called “spinning triangle”.

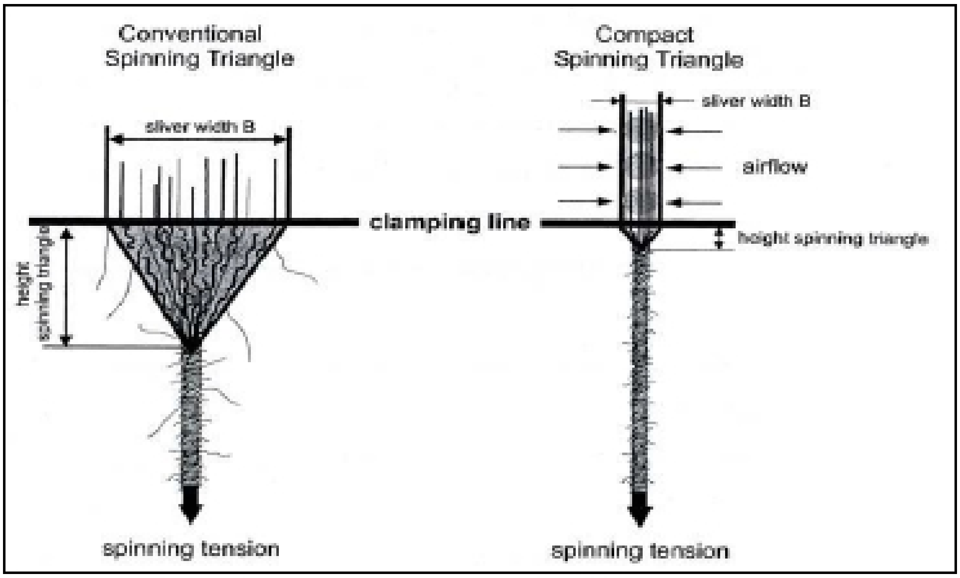

Figure 2: comparison of spinning triangles at conventional ring and compact spinning systems (jaswant rajaney,2008,10).

In rocos compact spinning, compact yarn is produced by adding positive nip at the end of the drafting unit. The condenser is held against the bottom front drafting roller by means of a magnet. The operation brings the fibers closer and eliminates the spinning triangle. The view of the rocos mechanical compact spinning principle is given in figure 3. According to the previous research, mechanical compact spinning significantly improves the imperfections and reduces its hairiness (Sevda & Kadoglu, 2009, 307).

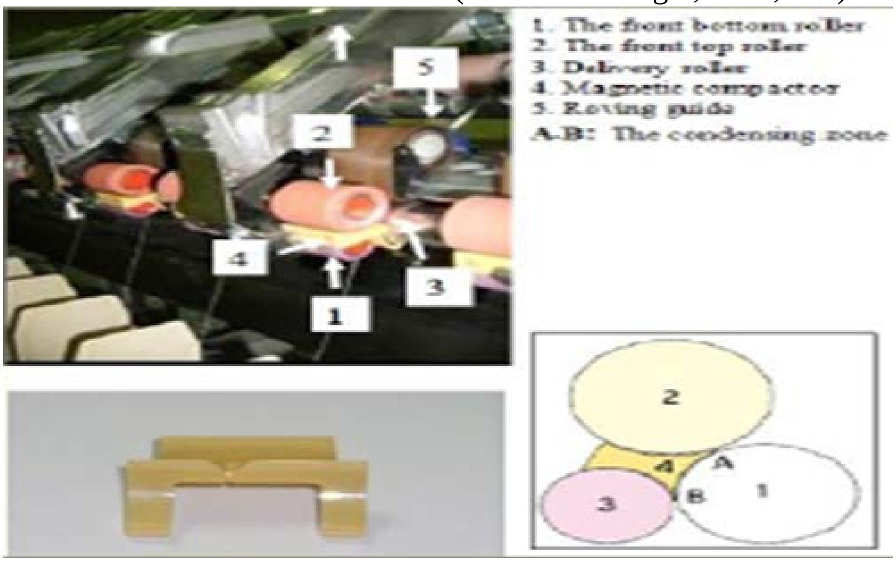

Figure 3: The view of rocos mechanical compact spinning and back view of magnetic compactor (Atlas & Kadoglu)

Experimental design

Material

Cis cotton was used to spin 40 ne combed yarn in conventional ring spinning machine (reiter) without compacting device and with mechanical compacting device (rocos) of rotorcraft company .the raw cotton was tested under standard testing atmospheric conditions at 20 ± 2˚ c and 65% rh (Booth, 2012) on hvi (high volume instrument) machine of premier art- 2 (Indian).

Method

To perform this experiment a reputed spinning mill of bangladesh was selected named as sinha rotor spinning ltd. (a concern of sinha spinning group). Various types of yarn are produced in this spinning mill such as combed yarn, carded yarn, compact yarn, rotor yarn (oe yarn), slub yarn, core yarn etc. The back process machineries of this mill are reiter brand but simplex machinery is toyota. The ring frame machine is reiter brand and rocos mechanical compacting device is used in this machine to produce compact yarn. In this study the raw cotton was processed from blow room to simplex at same process parameters. But to produce 40 ne combed yarn, conventional ring frame was used and to produce 40 ne combed compact yarn, conventional ring frame was used which are modified by simple mechanical compacting device (rocos) of rotorcraft company. Finally the quality parameters of yarn such as cv%, ipi (imperfection index) were tested on premier tester iq2 lx (evenness tester) and single yarn strength (rkm), elongation % were tested on premier tensomaxx (single yarn strength and elongation tester) under testing atmospheric conditions.

Experimental

Experimental results of raw cotton, finished yarn which were tested in different testing machineries are shown below:-

Table1: Properties of raw cotton fibers (hvi test results)

Cotton fibers test parameters	Mean value
Upper half mean length (mm)	28.66
Uniformity index (%)	82.6
Elongation (%)	6.7
Strength (g/tex)	34.10
Micronaire value (μ/inch)	5.01
Maturity ratio (m.r)	0.92
R_d	72.9
+b	10.7
Sfi (short fibre index)	8.6

Table 2: Setting parameters of ring frame machine for 40/1 ne combed yarn

Machine parameters	**Types of yarn**	
	Conventional ring spun yarn	**Compact yarn**
Twist per inch (tpi)	28.00	27.25
Ring traveler size	4/0	4/0
Spacer (mm)	2.50	2.50
Spindle speed (r.p.m)	16000	16500
Ring diameter (mm)	38	38

Table 3: Comparison of conventional ring spun yarn and mechanical compact yarn (40/1 ne combed yarn)

Quality parameters	**Conventional ring spun yarn**	**Mechanical compact yarn**
U_m %	9.65	9.20
Cv_m %	12.22	11.63
Thin -50%/km	1.00	1.3
Thick +50%/km	21.5	17.3
Neps +200%/km	111	67.7
Ipi (imperfection index)	133.5	86.3
Hairiness	3.32	2.34
Cv% of hairiness	5.12	3.48
Rkm (single yarn strength)	18.19	21.5
Cv% of rkm	9.21	8.12
Elongation %	5.11	5.93
Cv % of elongation %	11.06	9.5

Results and discussion:

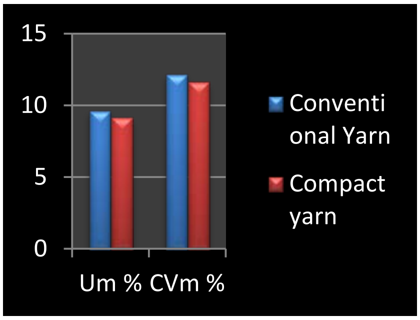

Figure 3: comparison of yarn um % And cvm %

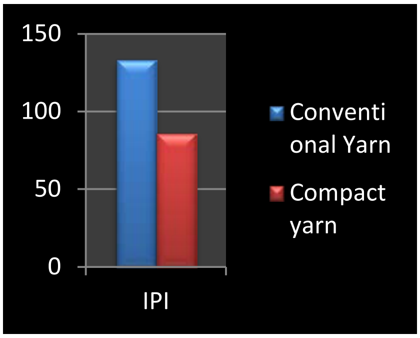

Figure 4: comparison of ipi (imperfection index)

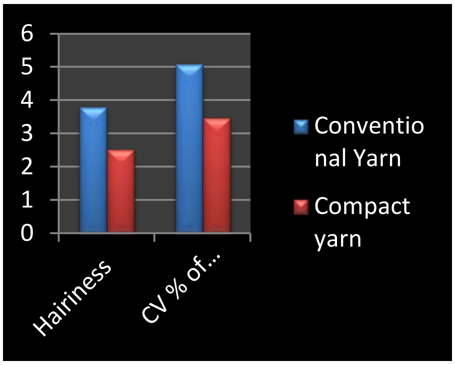

Figure 5: comparison of yarn hairiness

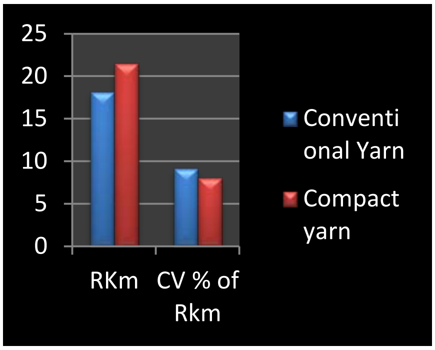

Figure 6: comparison of yarn rkm (single yarn strength)

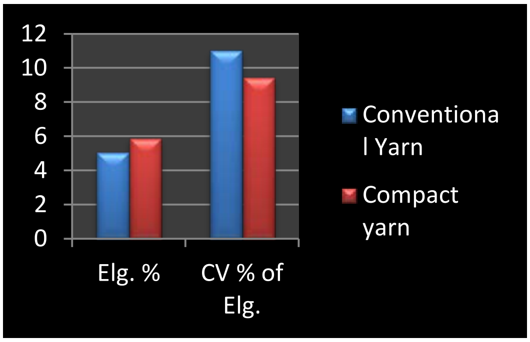

figure 7: comparison of elongation %

From figure-3, we see both um% and cvm% are less in compact spun yarn. So it's clear to us irregularity of compact spun yarn is reduced by using rocos in conventional ring frame machine.

From figure-4, we also see that ipi value of compact spun yarn is 86.3 where 133.5 in conventional ring spun yarn.so imperfections are reduced by using rocos.

From figure-5, we see that both hairiness and cv% of hairiness are less in compact spun yarn. So rocos improves the hairiness value of compact spun yarn.

From figure-6, we see that rkm (single yarn strength) value of compact spun yarn and conventional ring spun yarn are 21.5 and 18.19 repectively. So it reveals that rocos improves the strength of compact yarn as well.

From figure-7, we also see that the elongation% of compact yarn is higher than conventional ring spun yarn. So we can say elongation properties are improved by using rocos in conventional ring frame.

Conclusion

This study reveals that the positive effect of retrofitting of simple mechanical compacting device (rocos) on conventional ring spinning machine. The evenness and imperfection (ipi) values of compact yarns were found lower than conventional ring spun yarns. Compact yarn shows lower hairiness as compared to the yarn which is produced in conventional ring spinning machine. Increased yarn strength (rkm) and higher elongation properties also found in compact yarn. It also reveals that inspite of higher spindle speed and lower twist, compact yarn shows better yarn quality. To overcome the effect of spinning triangle and limited spindle speed of conventional ring spinning on yarn quality, it is necessary to modify conventional ring spinning machine by simple mechanical compacting device (rocos).

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