To Study the Influence of Different Compact Systems and Non-Compact System on Yarn Quality

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Abstract

A study has been attempted to deal with a comparison of compact yarn characteristics spun from three different commercial compact spinning systems namely Rieter's Com4 spin, Suessen's EliTe, LMW's RoCoS, and LMW's non-compact systems. In this study, we have compared the properties such as hairiness, imperfections, tenacity and elongation values of the yarns produced from the same back process material by the four systems separately for three counts Tex 14.76, 9.22 and 7.38(40^s,64^s,80^s Ne respectively). Project work study concludes that each system has its own unique principle and methods with optimized process parameters. From the trial taken we conclude that Com4 yarn manufacturing system results in better yarn strength, Evenness percentage, Whereas Elite yarn gives better results in hairiness and RoCos yarn gives better results in elongation percentage (in Tex 14.76) than other systems.

Keywords: Compact system, Hairiness, Elongation, Tenacity.

Introduction

For several decades, developments efforts in ring spinning were focused on improving the existing technology and incorporating automation and process linking capabilities. The first compact spinning machine was put into trial production in 1995 in some spinning mills in Switzerland. For the short staple spun yarns, low yarn hairiness was felt as the most desired property. Because, this property has given certain fullness for the fabric made out of it resulting in good warmth. The technological developments that had taken place in weaving and knitting process during the past few decades to achieve higher productivity demanded high tenacity and less hairy high performance yarns. This has resulted in the innovation of new yarn by name "Compact Yarn" in the short staple spinning system.

Compact or condensed spinning is a new concept of yarn forming. Fundamental modification of the conventional ring spinning system, that aims at producing a better surface integrity of spun yarn and maximizing strength. The eliminated spinning triangle is a by-product of this concept. This close and parallel arrangement of fibres immediately before twisting is imparted is responsible for the characteristics advantage of compact yarn. The conventional ring yarn shows to be far less perfect than commonly assumed. The long, protruding fibres cause a number of problems in downstream processing.

The operating method of the Suessen elite spinning is well known. After the fibres leave the drafting system they are condensed by an air permeable lattice apron which slides over an inclined suction slot and at the same time they perform a lateral rolling motion. The principle of magnetic compacting allows both peripheral fibres and fibres at the core to remain under equal tension which contributes in enhancing the strength of the yarn. In addition the cohesiveness between the fibres is improved due to the controlled movement of fibres and this, in turn does not allow the fibres to deviate from its axis resulting in the reduction of protruding hairs.

Com4 Compact System

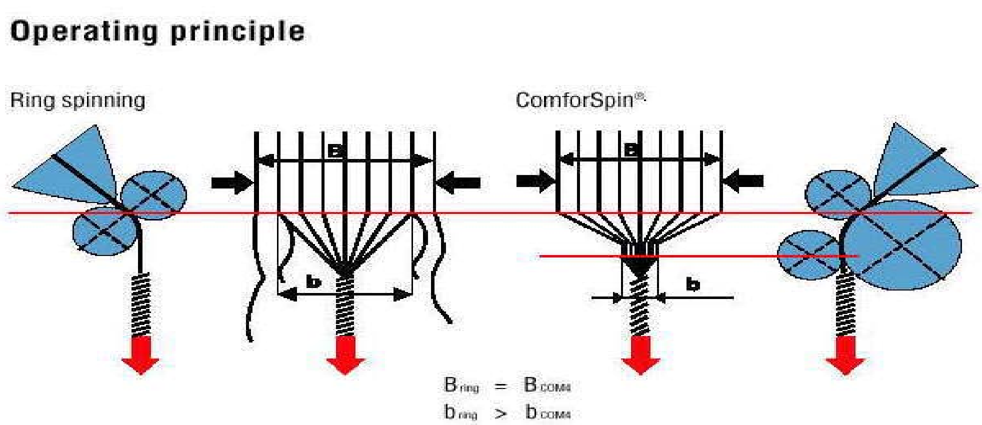
Com4 concept:

With the Com4 spin technology a new yarn with perfect yarn structure has been established in the market. With the help of a microscope the structure of the yarns can easily be compared: The conventional ring yarn shows to be far less perfect than commonly assumed. The long, protruding fibres cause a number of problems in downstream processing. Com4 yarn shows a very compact structure with highly parallel fibres and much less disturbing hairiness.

The air current created by the vacuum generated in the perforated drum condenses the fibres after the main draft. The fibres are fully controlled all the way from the nipping line after the drafting zone to the spinning triangle.

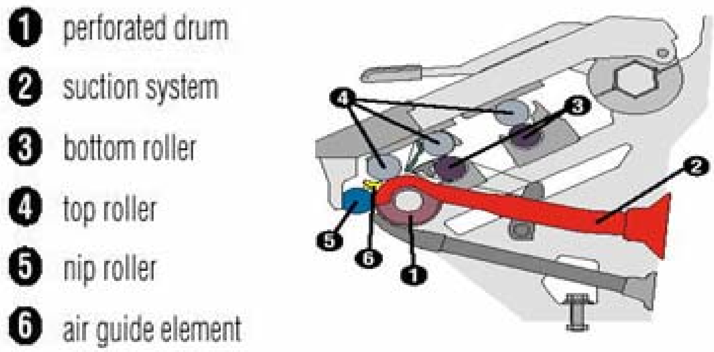
An additional nip roller prevents the twist from being propagated into the condensing zone. The compacting efficiency in the condensing zone is enhanced by a specially designed and patented air guide element.

Optimal interaction of the compacting elements ensures complete condensation of all fibres. This results in the typical COM4 ® yarn characteristics.



The Com4Spin technology allows aero-dynamic parallelization and condensation of the fibres after the main draft. The spinning triangle is thus reduced to a minimum. The heart of Com4Spin machine is the compacting zone, consisting of the following elements:

a) Perforated drum b) Suction insert c) Air guide element




Perforated Drum

The directly driven perforated drum is hard to wear and resistant to fibre clinging. Inside each drum there is an exchangeable stationary suction insert with a specially shaped slot. It is connected to the machine's suction system.

Elite Compact System

Elite Yarn: The operating method of the SUESSEN Elite Spinning System is well-known. After the fibres leave the drafting system they are condensed by an air-permeable lattice apron, which slides. over an inclined suction slot. The fibres follow the outer edge of this suction slot and at the same time they perform a lateral rolling motion.

Above the front bottom roller of the drafting system, the fibre band influenced by high draft is spreading. In the area of the suction slot, which is covered by the lattice apron, the fibre band is condensed. Commencing from the semi-dotted clamping line of the Elite Q Top Roller, twist is being inserted. There is no spinning triangle. The left side displays the fibre triangle at the exit of a conventional ring frame drafting system. The twist imparted by the spindle cannot flow up to the clamping line. The outer fibres spread out and are thus more highly tensioned than those on the inside. The right side of the picture does not show a spinning triangle. The yarn twist flows right up to the clamping line. The yarn is round and smooth.

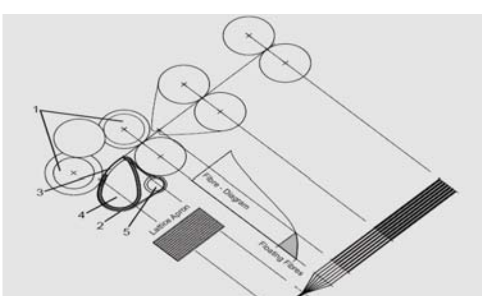
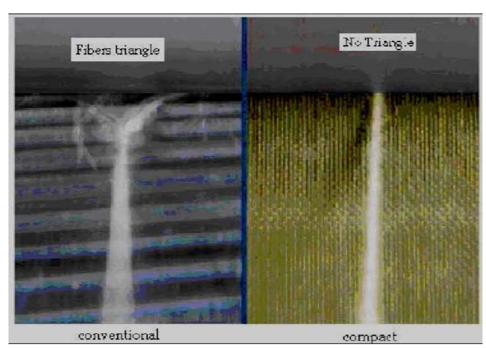


Fig. 2



Since the spinning triangle is very small, the end breaks will be very less and therefore the fly liberation will also be less. Condensing of the fibre bundle, which follows the drafting process, can already be seen as a significant development of the ring spinning technology. Condensed ring yarn is more than a specialty.

It is of technological importance that the suction level relevant for the condensing operation is exactly the same for all spinning positions. To fulfill this criteria, individual motors combined with suction units for spinning positions, have been arranged accordingly. This provides short air-flow distances with identical negative pressures at all spinning points.

During yarn formation all fibres are perfectly condensed and gathered parallel to each other in the compacting zone. Consequently all fibres are twisted in and contributing to the superior fibre utilization rate compared to conventional ring yarn. The result is exceptionally low hairiness combined with higher yarn tenacity and elongation. These are the unique characteristics of these yarns.

RoCoS compact system-Any ring spinning machine can be converted nto RoCos system. As shown in figure, bottom roller 1 supports the front roller 2 and delivery roller 3.

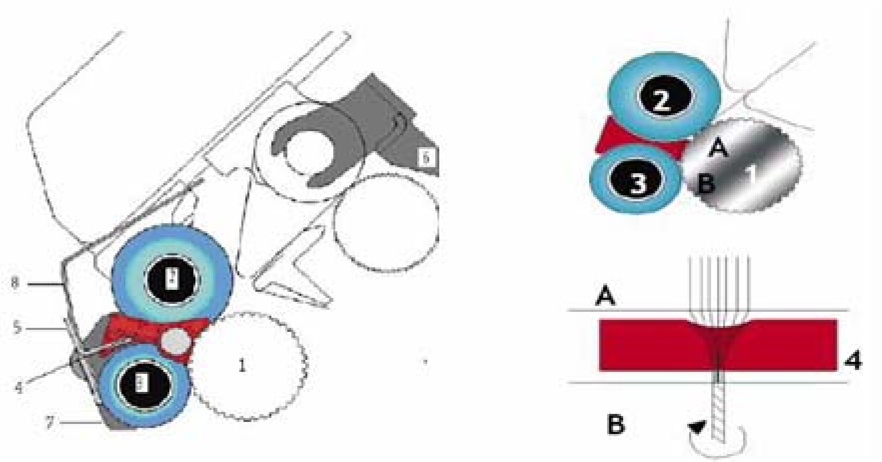


Fig: Compacting zone of RoCos System

Condensing zone extends from clamping line A to clamping line B. The front bottom roller (1) supports the front top roller (2) and the delivery roller (3). The compacting zone extends from clamping line (nip point) B. Both top rollers are friction driven by roller 1 and always have the same circumferential speed, irrespective of their diameters. As there is no draft between nip point A and B, fibres or filament longer than the distance A-B will not suffer elongation or break. A high precision ceramic compactor (4) is pressed by inserted permanent magnet without clearance against the front bottom roller. Compactor and bottom roller together form an enclosed compression chamber. The compacter slides safely and well positioned over the fluted surface of the bottom roller, which transports synchronously the strands of fibres through the compacting channel. The delivery roller ensures fibre transport continuity and stop twist entering the compacting zone. RoCoS guarantees optimal compacting. It is simple, reliable and produces consistently high-level compact yarns without increasing the cost of ring spinning.

Material and Methods used for testing

100% cotton combed compact yarns Tex 14.76 (40^s Ne), Tex 9.22 (64^s Ne) and Tex 7.38 (80^sNe) were produced on each system. This count range was chosen since it covers a medium to finer count. It was necessary to use different roving for different counts to be able to produce yarn count range required without any difficulty. The fibre properties and mixing details are as shown in table 1 and roving details are as shown in table 2.On each machine, the same 100 spindles were also used during the production of different yarn counts to minimize the variation in quality.

Mixing Details

Mixing	**Pima 100%**	**Bunny 100%**	**DCH Organic**
COUNT	Tex 14.76 (40^s Ne)	Tex 9.22 (64^s Ne)	Tex 7.38 (80^sNe)
MIC (Micronaire)	3.83	3.72	3.36
MAT (Maturity)	0.91	0.85	0.85
UHML (Upper Half Mean Length)	36.07	32.04	33.11
SFI (Short Fibre Index)	5.88	7.29	6.3
UI (Uniformity Index)	87.16	84.07	86.37
ELOGATION %	6.6	5.76	6.61
STRENGTH	41.16	30.8	37.93
Rd	68.73	77.66	69.85
+b	12.22	8.52	10.73

Spinning particulars for Tex 14.76 (40^s Ne)

PARAMETER	RIETER COM4	LMW NORMAL	LMW ROCOS	LMW SUESSEN
Yarn TM	3.8	3.8	3.8	3.8
Spindle speed (Avg.)	18000 rpm	18000 rpm	18000 rpm	18000 rpm
Traveler	4/0 EL1 UDR Maxima	4/0 EL1 UDR Maxima	4/0 EL1 UDR Maxima	4/0 EL1 UDR Maxima
Break draft	1.19	1.19	1.19	1.19
Total draft				
Ring dia in mm	38 mm	38 mm	38 mm	38 mm
Spacer in mm	4 mm	4 mm	4 mm	4 mm
Cop content	45-55gm	45-55gm	45-55gm	45-55gm

Spinning particulars Tex 9.22 (64^s Ne)

PARAMETER	RIETER COM4	LMW NORMAL	LMW ROCOS	LMW SUESSEN
Yarn TM	4.24	4.24	4.24	4.24
Spindle speed (Avg.)	18000 rpm	18000 rpm	18000 rpm	18000 rpm
Traveler	18/O EL1UDR Sapphire	18/O EL1UDR Sapphire	18/O EL1UDR Sapphire	18/O EL1UDR Sapphire
Break draft	1.19	1.19	1.19	1.19
Total draft				
Ring dia in mm	38 mm	38 mm	38 mm	38 mm
Spacer in mm	3.5 mm	3.5 mm	3.5 mm	3.5 mm

Spinning particulars Tex 7.38 (80^s Ne)

PARAMETER	RIETER COM4	LMW NORMAL	LMW ROCOS	LMW SUESSEN
Yarn TM	3.8	3.8	3.8	3.8
Spindle speed (Avg.)	18000 rpm	18000 rpm	18000 rpm	18000 rpm
Traveler	18/O EL1UDR Sapphire	18/O EL1UDR Sapphire	18/O EL1UDR Sapphire	18/O EL1UDR Sapphire
Break draft	1.19	1.19	1.19	1.19
Total draft				
Ring dia in mm	38 mm	38 mm	38 mm	38 mm
Spacer in mm	3.5 mm	3.5 mm	3.5 mm	3.5 mm
Cop content	35-40gm	35-40gm	35-40gm	35-40gm

Yarn test results for Tex 14.76 (40^s Ne)

Properties	LMW Normal		Rieter Com4		LMW RoCoS		LMW Suessen	
	Cop	**Cone**	**Cop**	**Cone**	**Cop**	**Cone**	**Cop**	**Cone**
Avg. count	Tex 14.48 (40.77)	Tex 14.53 (40.62)	Tex 14.47 (40.05)	Tex 14.72 (40.11)	Tex 14.90 (39.62)	Tex 14.88 (39.66)	Tex 14.59 (40.45)	Tex 14.45 (40.85)
Count CV%	1.14	1.07	0.89	0.51	1.65	1.06	0.91	0.86
U%	9.76	10.10	8.96	8.96	9.13	9.23	9.56	9.91
IPI values (+50%, -50%, +200%)	50.3	33	19.9	28.5	32.5	32.5	38.1	34.2
Hairiness Index	3.53	4.31	3.24	3.97	3.06	3.06	2.62	2.81
Elongation %	5.46	5.59	4.66	5.02	5.35	5.51	5.17	5.48
Tenacity g/tex	28.81	28.20	31.05	30.66	30.16	29.69	29.70	29.73

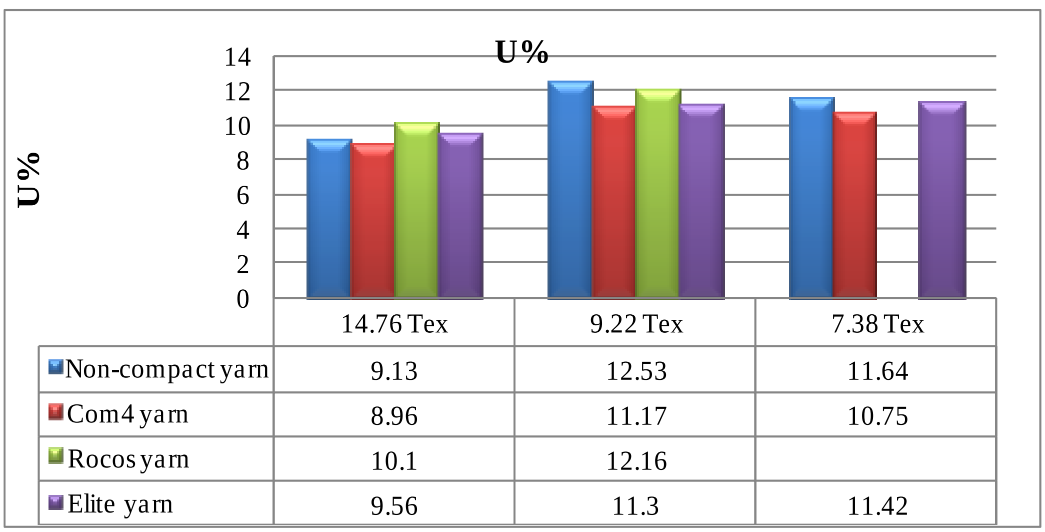
Yarn test results for Tex 9.22 (64^s Ne)

Properties	LMW Normal		Rieter Com4		LMW RoCos		LMW Suessen	
	Cop	**Cone**	**Cop**	**Cone**	**Cop**	**Cone**	**Cop**	**Cone**
Avg. count	Tex 9.02 (65.41)	Tex 9.13 (64.65)	Tex 9.25 (63.82)	Tex 9.27 (63.69)	Tex 9.03 (65.33)	Tex 9.15 (64.51)	Tex 8.97 (65.78)	Tex 9.33 (63.26)
Count CV%	1.60	2.19	1.53	1.64	1.38	1.01	1.32	1.37
U%	12.12	12.53	11.07	11.17	11.87	12.16	11.62	11.30
IPI values (+50%, -50%, +200%)	426.16	679.5	229.1	322.5	336.3	502.5	296.1	265
Hairiness Index	4.04	4.72	2..83	3.18	2.81	3.74	2.61	2.86
Elongation %	4.12	4.43	4.30	4.52	3.62	4.17	4.26	4.70
Tenacity g/tex	19.07	19.04	23.34	23.36	21.5	20.66	21.39	22.64

Yarn test results for Tex 7.38 (80^s Ne)

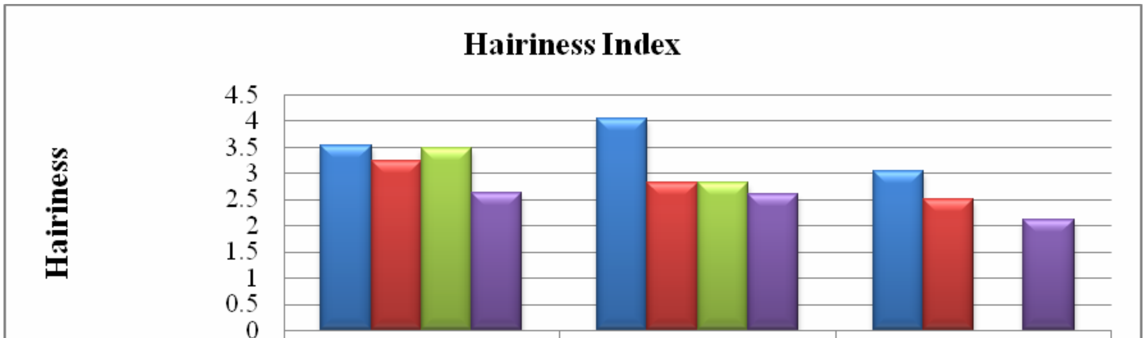
Properties	LMW Normal		Rieter Com4		LMW Suessen	
	Cop	Cone	Cop	Cone	Cop	Cone
Avg. count	Tex 7.34 (80.44)	Tex 7.31 (80.73)	Tex 7.35 (80.32)	Tex 7.33 (80.50)	Tex 7.41 (79.61)	Tex 7.44 (79.27)
Count CV%	1.39	0.89	0.97	1.51	1.01	1.21
U%	11.64	12.57	10.75	11.02	11.42	11.63
IPI values (+50%, -50%, +200%)	323.1	640.5	216.6	274.1	279.1	400
Hairiness Index	3.05	3.65	2.50	2.54	2.1	2.14
Elongation %	4.63	5.05	4.31	4.90	4.56	5.36
Tenacity g/tex	22.10	22.24	25.37	26.61	23.10	25.52

Unevenness percentage



Inference: Table shows that the evenness (U %) of Com4 yarn is better than all spinning system

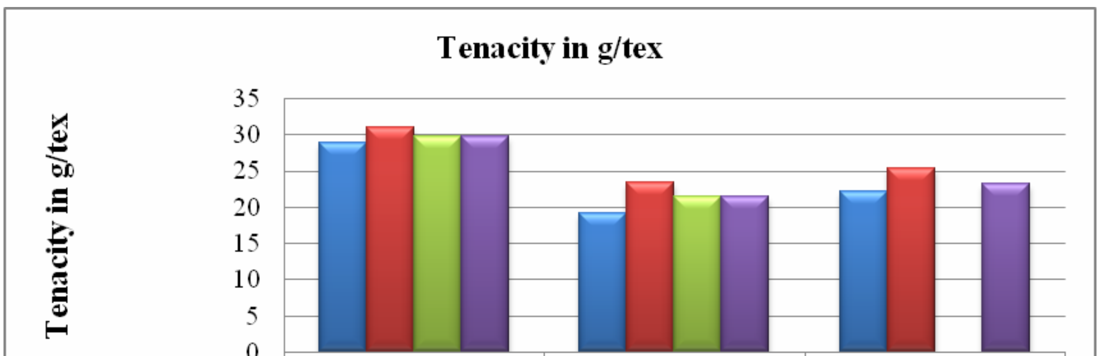
Hairiness Index



	14.76 Tex	9.22 Tex	7.38 Tex
Non-compact yarn	3.53	4.04	3.05
com4 yarn	3.24	2.83	2.5
RoCos yarn	3.49	2.81	
Elite yarn	2.62	2.61	2.11

Inference: Figure shows that the hairiness results are better in Elite compact system in all yarn count systems.

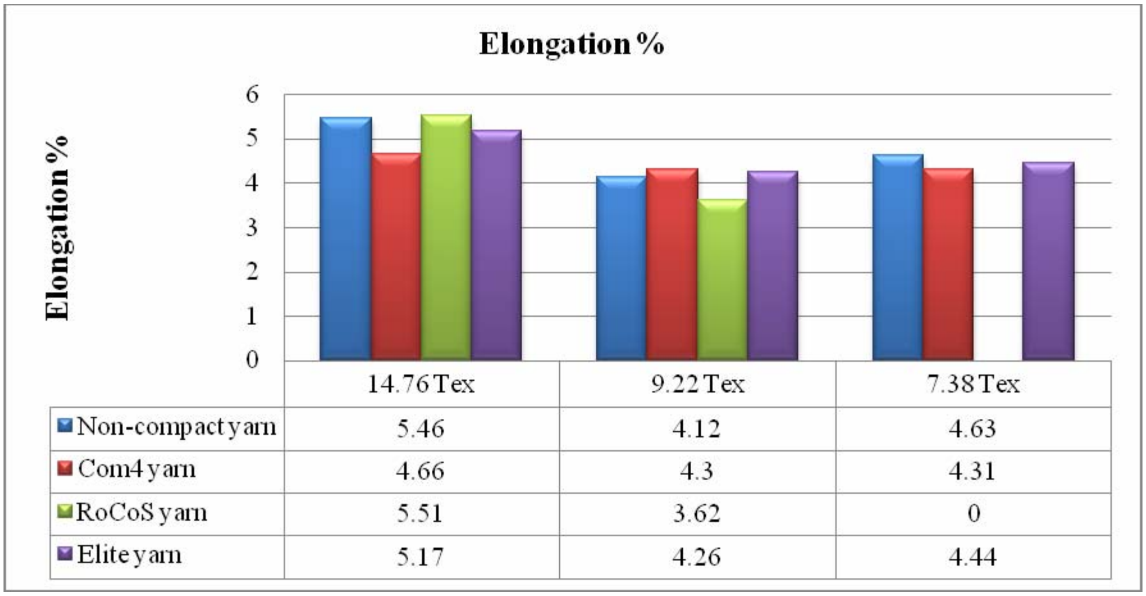
Tenacity in (g/tex)



	14.76 Tex	9.22 Tex	7.38 Tex
Non-compact yarn	28.81	19.07	22.1
Com4 yarn	31.05	23.34	25.37
RoCos yarn	29.69	21.5	
Elite yarn	29.7	21.39	23.23

Inference: Figure shows that the tenacity of the Com4 yarn is better in the all yarn counts and next elite results are better.

Elongation %



Inference: Figure shows that the Elongation % is better in RoCos yarn for 40^s count & Com4 is better for 80^s, 64^s counts.

Conclusion

Project work study concludes that each system has its own unique principle & methods with optimized process parameters. From the trial taken we conclude that Com4 yarn manufacturing system results in better yarn strength, Evenness %, Whereas Elite yarn gives better results in Hairiness. And RoCos yarn gives better results in elongation % than other systems. With same process parameters at each stage from blow room to cone stage with respect to count and mixing.

Following table shows the comparison of three compact spinning systems with non- compact system in difference percentage.

Table: Summary of results in improvement percentage

Count	Tex 14.76 (40^{s}Ne)			Tex 9.22 (64^{s}Ne)			Tex 7.38 (80^{s} Ne)		
Systems	Com4 yarn	RoCos yarn	Elite yarn	Com4 yarn	RoCos yarn	Elite yarn	Com4 yarn	RoCos yarn	Elite yarn
U%	**+11.28 %**	-3.36%	-5.34 %	**-8.66%**	-2.06%	-4.12%	**-7.64%**	NA	-1.89%
Total IPI	**-60%**	-35.38%	-24.25 %	**-34.30%**	-21.07%	-30.50%	**-32.96%**	NA	-13.61%
Hairiness Index	-8.21%	-13.31%	**-25.77 %**	-29.95%	-30.44%	**-35.39%**	-18.02%	NA	**-31.14%**
Tenacity in g/Tex	**+7.21 %**	+4.47%	+2.99 %	**+18.29%**	+10.84 %	+11.30%	**+12.88%**	NA	+4.32%
Elongation %	+14.65 %	**+20.1%**	+5.31 %	+4.18%	**+12.13 %**	+3.28%	**+6.91%**	NA	+1.51%
Single yarn strength in gms	**+7.25 %**	+2.96%	+3.20 %	**+18.29%**	+10.79 %	+11.13%	**+12.75%**	NA	+5.39%

Inference

- Table shows that as compare to non-compact yarn strength increasing % is higher in Com4 system is higher than other systems.
- U% decreasing% is also higher in Com4 yarn.
- Hairiness decreasing % is higher in elite yarn as compare to other systems.
- Elongation increasing% is higher in RoCos yarn.
- And obviously the Rkm & single yarn strength increasing % is higher in Com4 yarn.

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