COMPARATIVE ASSESSMENT OF YARN PROPERTIES PREPARED ON DIFFERENT COMPACT SPINNING SYSTEMS

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Abstract: *The stiff competition and complex market scenarios make it inevitable for the textile companies to produce best possible quality material at the least possible cost. While the compact spinning technologies available today are capable of producing very fine and quality yarns, picking the right system for an industry could be overwhelming. This therefore demands a detailed analysis of different compact spinning systems with respect to the yarn quality produced, workability and the complete costs involved in installation and running these systems. This paper reports a glimpse on the yarn quality produced and the workability of some of the major compact spinning systems and presents a comparison amongst them.*

Keywords: Lakshmi RoCoS, Reiter K44, Suessen ELiTe.

1. Introduction

Yarn production techniques and the structure of the yarn are the basic elements which influence its quality and that of the subsequent products. Ring spinning system invented by John Thorpe in 1830 has been very successful in producing yarns from staple fibres. The yarn produced however, requires certain treatments such as sizing, waxing, singeing, etc. to enhance the efficiency of the subsequent processes and produce an end product of the desired quality[1]. Yarn produced on the ring frames having compact spinning attachments on the other hand, exhibit better properties in terms of strength, hairiness, uniformity and lusture. This is achieved by shortening the width of the fiber band emerging out of the front drafting roller of ring frame which allows the fibers to bind better into the yarn.

With the advent of a number of different compact spinning systems, it might be overwhelming to choose one for an industry's specific needs. This paper therefore reports a comparison between major compact spinning systems in terms of the yarn quality produced, workability of the machine and the working conditions. The compact spinning systems compared are Suessen ELiTe compact spinning system, Lakshmi rotorcraft compact spinning system (RoCoS), and Reiter Comforspin (Reiter K44) compact spinning system.

2. Experimental

60^s Ne yarn samples were spun on each of the three systems keeping all the yarn and production parameters same (except the spindle speed since, the yarn breakages in the Lakshmi RoCoS system shot up at high speeds). The spindle speed for Lakshmi RoCoS compact spinning system was therefore 16000 rpm while it was 22500 rpm for Suessen ELiTe and Reiter K44 systems. The yarns were spun from 1.40^s Ne roving made up of 100% MCU-5 cotton fiber. The twist multiplier was 4.3. The quality of yarn was tested on Uster Tester-5 (UT-5), Uster Tensorapid-3 (UTR-3), Uster Tensojet (UTJ) and Uster Classimate-3 after conditioning the yarns in laboratory atmosphere for 24 hours. 10 yarn samples were selected from each compact spinning system and 10 tests were performed on each of them on UT-5, UTR-3 and UTJ. The Uster Classimate testing was done on 6 randomly selected samples from each compact sinning system.

Workability of the systems was studied by doing a breakage study where the yarn breakages after restarting the production after replacing full cops with empty cops (start-up breakages) and total yarn breakages during a full doff (running breakages) were noted down. Percentage of start-up breakages per spindle hour is calculated as

$$s = \frac{n_s}{n_{esp}} X\,100 \tag{2.1}$$

Percentage of running breakages per spindle hour is calculated as

$$r = \frac{n_t}{t_d n_{esp}} X\,100 \tag{2.2}$$

where

n_s is the number of breakages at the start of a new doff

n_{esp} is the number of the effective spindles working on machine

t_d is the time taken in hours to finish a doff

Working conditions such as fly and noise generation and apron and top clearer loading were studied and recorded based upon the feedback from operators and personal observations.

3. Results and discussions

3.1 Yarn quality parameters

Figure 1 shows a comparison of the yarn quality parameters for the yarns produced on different systems. The figure shows that the quality parameters such as Uster % (represents the mass unevenness in yarn), and hairiness index are comparable in all the three systems. However, the Imperfection index (measure of thick, thin places and neps in yarn) is slightly different in the three systems. Reiter K44 exhibits highest Imperfection index while Lakshmi RoCoS exhibits the lowest. This may be attributed to the slow spinning speed of the Lakshmi RoCoS system.

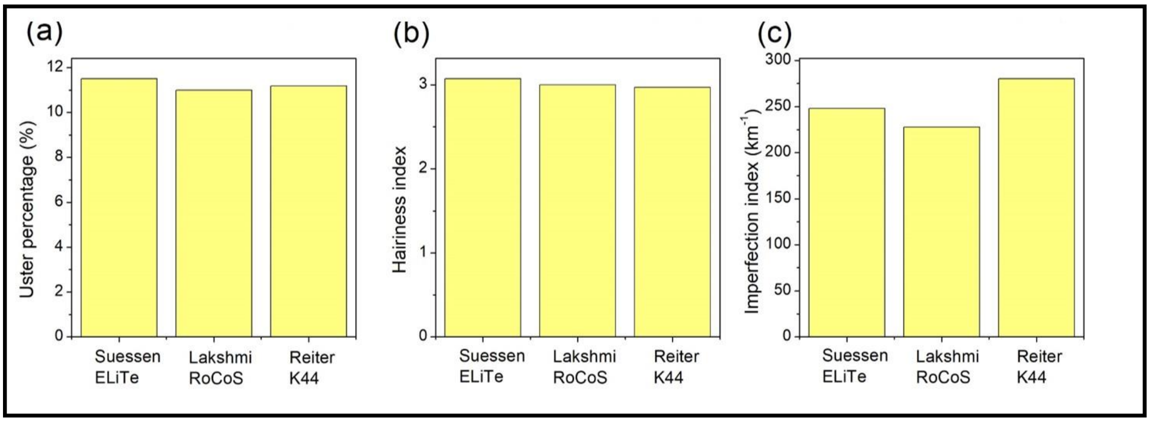

Figure 1: Comparison between the quality parameters of different compact spinning systems i.e. (a) Uster percentage; (b) Hairiness index and (c) Imperfection index

The tensile behavior exhibited by yarn on Uster Tensorapid-3 (UTR-3) and Uster Tensojet (UTJ) are shown in Figure 2 and Figure 3, respectively. The highest RKM and elongation values were obtained for the Reiter K44 system. Figure 2 shows highest RKM and elongation values for the Comforspun yarn but with a highest RKM CV %age. Highest minimum RKM is observed in the case of yarn spun on Lakshmi RoCoS spinning system. These results are further verified by the UTJ results shown in Figure 3. These results maybe attributed to the difference in the compacting mechanism of the three systems. While the compacting in Lakshmi RoCoS is carried out mechanically by a ceramic compactor loaded magnetically which collects the fibers together thus, reducing the width of the spinning triangle. Suessen ELiTe on the other hand use vacuum pressure through a slit covered by a thin ribbon to bring the fibers closer and Reiter K44 does the same with the help of vacuum pressure generated through a perforated drum in the front bottom position.

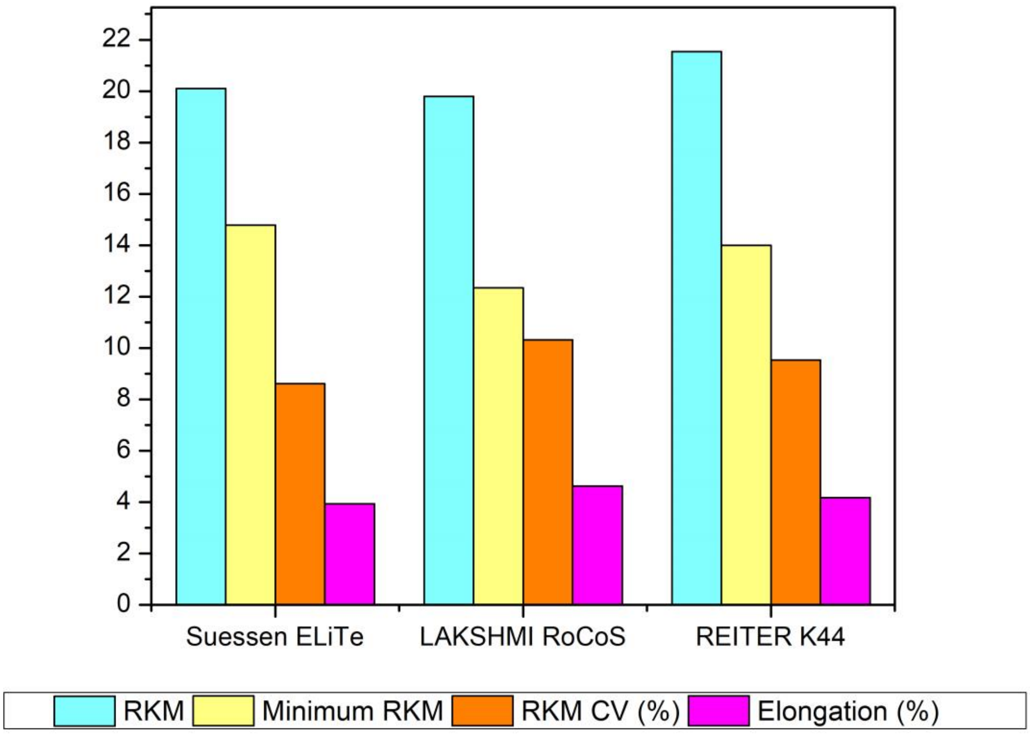

Figure 2: Comparison between the Uster Tensorapid-3 results obtained for yarns spun on different compact spinning systems.

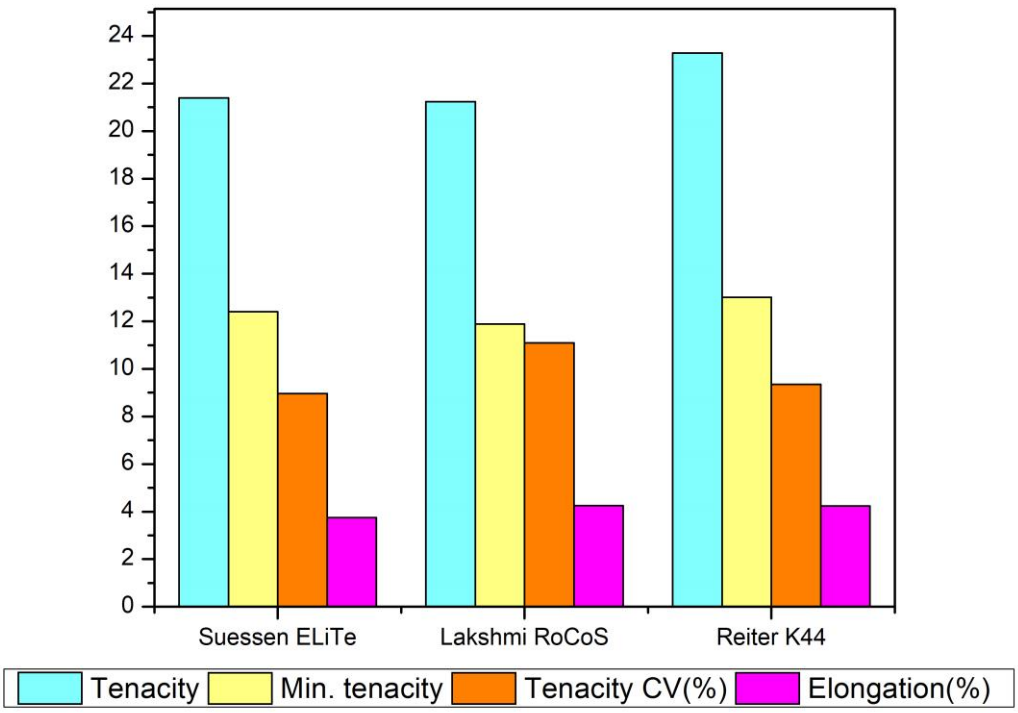

Figure 3: Comparison between the Uster Tensojet results obtained for yarns spun on different compact spinning systems.

Figure 4 shows that the yarn produced on Reiter K44 shows minimum no. of objectionable faults, however it shows maximum no. of H1 faults. The long thick and long thin places are maximum in case of yarn produced on Lakshmi RoCoS spinning system.

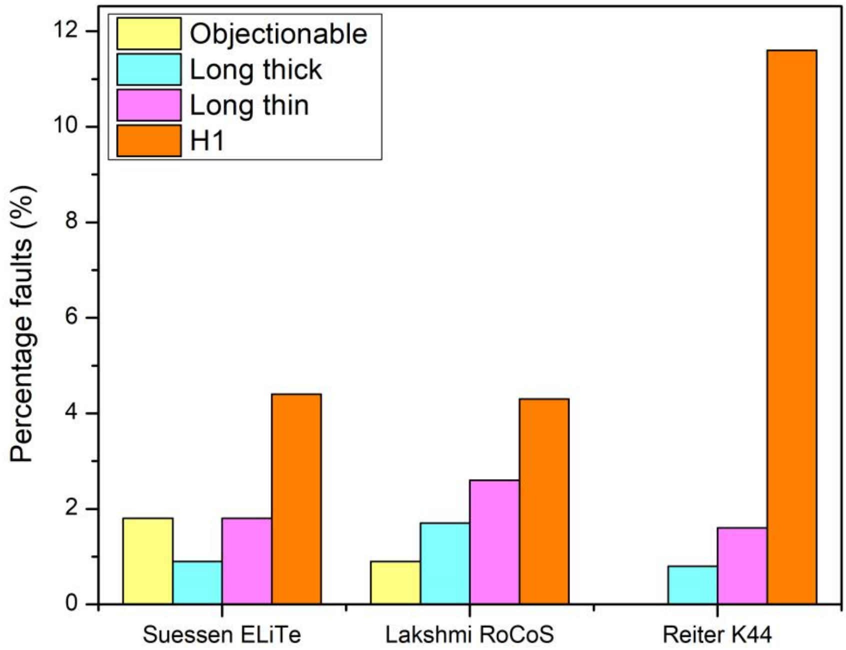

Figure 3: Comparison between the Uster Classimate faults observed for yarns spun on different compact spinning systems.

3.2 Workability

It can be observed from the Table 1 that the Reiter K44 shows least breakages both in case of starting and running breakages. Suessen Elite compact system shows a very high start up breakages. These results are due to the differences in the designs and features of different spinning systems and the type of compacting elements. The mesh and lattice aprons are more prone to damages and loading than to the perforated drum. Workability results of Lakshmi RoCoS compact spinning system are not given because it was a sample line and was run just for the trial purpose, also the number of breakages above 16000 rpm spindle speed was very high.

Table 1: Breakages observed in Suessen ELiTe and Reiter K44 compact spinning systems

	Suessen ELiTe	Reiter K44
Percentage start-up breakages / spindle hour	7.3	4.2
Percentage start-up breakages / spindle hour	2.95	1.9

3.3 Working conditions

The comparative working conditions for the Suessen ELiTe and Reiter K44 systems were studied based on the feedback received from the machine operators and personal experiences. Since, Lakshmi RoCoS was in a sample line and others were in the production floor, its working conditions were could not be compared to the other two systems.

Table 2: Comparative working conditions around Suessen ELiTe and Reiter K44 compact spinning systems

	Suessen ELiTe	Reiter K44
Fly and fluff generation	High	Low
Noise	Very high	High
Mesh/lattice apron loading	Low	Not applicable
Top roll clearer loading	Not applicable	Low

4. Conclusion

The yarn produced on Lakshmi RoCoS spinning system and the Reiter K44 systems gives better yarn quality results; however the difference is not significant. The performance results show that the RoCoS Compact Spinning System shows good quality results, but since this system has a maximum practical speed limit of 16000 rpm. This is not an ideal spinning system for the production oriented industries. From the breakage point of view the Reiter's K44 compact spinning system proves to be the best out of the three systems. This can be attributed to the perforated drum used for the compaction which is much sturdier and aligns the fibers parallel to each other in a better way compared to the other systems. Study of working conditions reveal that the fly and fluff generation in the Reiter K44 compact spinning system is lower than that of the Suessen ELiTe compact spinning system. The noise generated in the Reiter K44 is also much more tolerable than the Suessen ELiTe compact spinning system.
Thus, from the entire discussions one can easily conclude that each of the compact spinning system offers some distinct advantages and it depends upon the requirement of the users to choose the best system according to them.

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