A Review on Compact Spinning

By:
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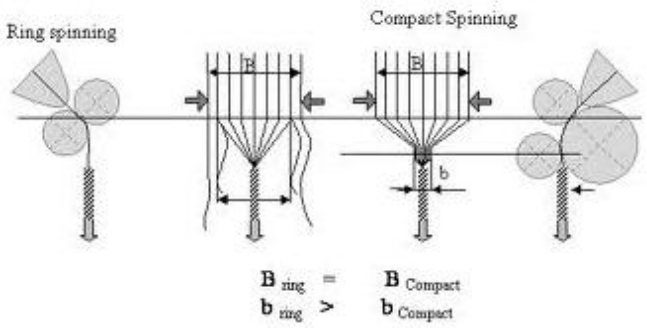
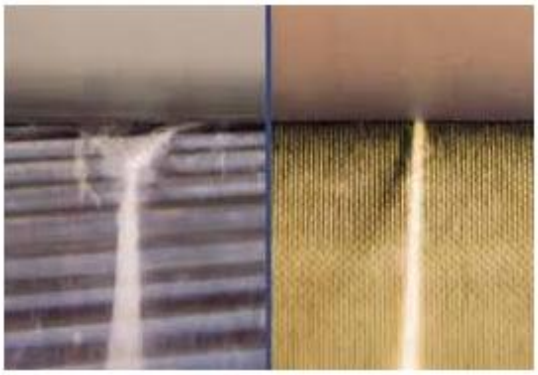
The developments in spinning systems from mule spinning, cap spinning, flyer spinning and then ring spinning to the today's latest spinning systems like rotor spinning, airjet spinning shows an ultimate ways to produce yarn. However, the versatility of ring spinning has created its own root in todays spinning world. The compact spinning is one of the major developments in the history of spinning, as the improved properties of compact yarn over conventional ring yarn.

Basic problems associated with conventional ring frame:-

The width of fiber strand fed is always more than width of spinning triangle. The width of spinning triangle is depends upon spinning tension and is directly related with spinning tension. Basically, the restriction of twist flow to the front roller nip, because of spinning geometry, causes the formation of spinning triangle. The fibers at selvedge of fiber strand, delivered by front roller may not get fully integrated into yarn body or they may gets lost through pneumatic suction tube (PN waste), because in the spinning triangle, the selvedge fibers are always at very high tension than inner ones and due to improper integration of selvedge fibers into yarn, the hairiness rises up.





Also the spinning triangle is the major weak place in yarn formation zone and therefore most of the end breaks in ring frame are occurring in spinning triangle and which is largely influencing the machine efficiency. Therefore it needs to have control over formation of spinning triangle and which is made possible by compact spinning.

What is compact spinning?

The compact spinning is a process where fiber strand drawn by drafting system is condensed before twisting it.

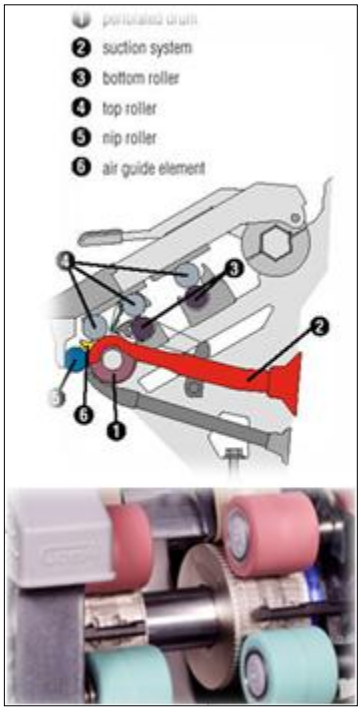
Following methods are used by machine manufacturers to condense the fiber strand.

1. 1. Aerodynamic condensing.
2. Mechanical condensing.
3. Magnetic condensing.

The most important requirement for perfect compact yarn is complete parallel arrangement of fibers and close position before twist is imparted. By keeping this point into consideration different machine manufacturers have developed different methods of compact spinning.

COM4spin system of Rieter:

In this system, the condensing is done by aerodynamic force. The delivery bottom roller of drafting system is replaced by perforated drum. The fixed suction system under the perforated drum creates vacuum, which generates air current on drum. The air guide element plays important role in condensing process, as air is guided by air guide element & this air current helps to condense the fiber strand. This condensing of fiber strand considerably reduces the width of spinning triangle and hence problems associated with spinning triangle. The yarn produced on this system is named by Rieter as COM4 yarn. Where COM stands for comfort and 4 indicates the four basic advantages of COM4 yarn mentioned below.



1. Reduced hairiness.
2. Maximum strength and elongation.
3. Minimum environmental impact.
4. Unequalled wearing comfort.

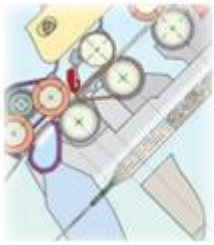
The COM4 value can be calculated,

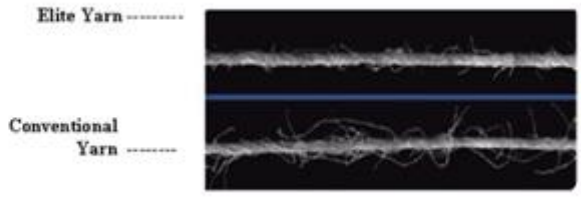
COM4 value=100000 / [yarn twist tpm*yarn hairiness H]

This value indicates the improvement in COM4 yarn quality.

Suessen Elite compact spinning system:

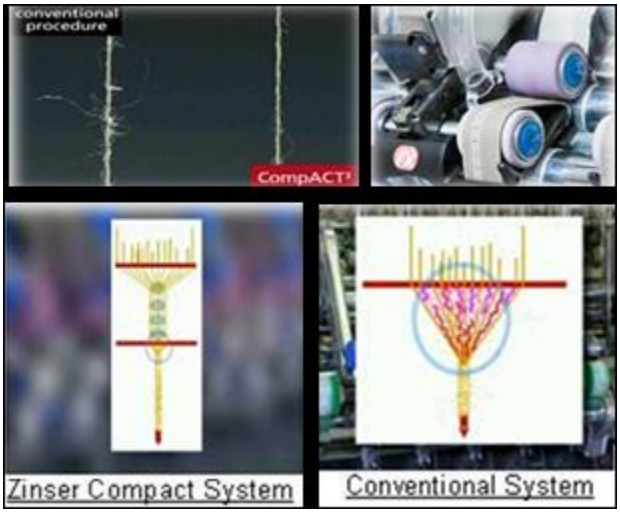
In the Elite system of suessen, the condensing zone following the front drafting roller and it consists of profile tube with suction slot which is placed at certain angle to the flow of fibers, perforated lattice apron and delivery top roller. The lattice apron is driven by delivery top roller and which is driven by gear drive from front top roller of drafting system. The suction under the tube creates the air currents through slot and lattice apron which are responsible for condensing and perfect parallelization of fiber strand. The suction air pressure, size of slot, speed of apron, number of holds in the lattice apron has an influence on condensing action.





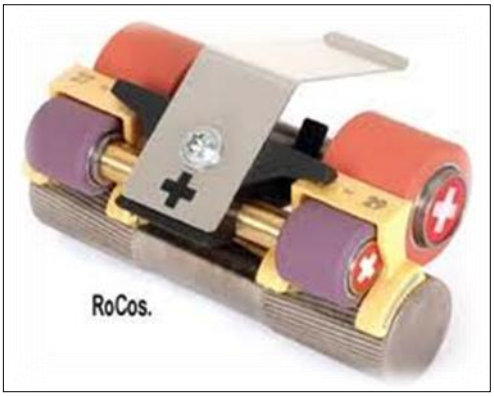
CompACT3 system of zinser:

The compACT3 system of zinser works on aerodynamic compacting principle. The condensing zone following the conventional 3/3 roller, double apron drafting system and it consists of perforated apron with special vacuum element for correct air current and drive for the perforated apron.

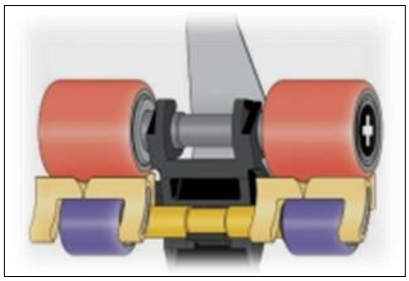


The special vacuum element generates the air current underneath the apron. The special arrangement of circular and elliptical perforations on apron insures the better compacting effect. The fiber properties largely influencing the condensing process e.g. stiff fibers behaves in different manner than a flexible ones. The fiber tension in compacting zone has influence on yarn quality. Therefore for cotton compact spinning process, 0-4% overfeeding is required as per raw material.

RoCoS-magnetic compacting system:



RoCoS stands for 'RotorCraft compact spinning' system which was developed by Hans Stahlecker of Rotorcraft Maschinenfabrik Switzerland and is available on ring frames of Lakshmi Machine Works (LMW). The RoCoS works without use of air suction. Magnetic mechanical compacting principle is used in RoCoS system. The RoCoS device consists of front bottom roller which supports the front top roller and delivery roller; in between these two rollers the ceramic compactor is placed. The supra magnets are equipped with ceramic compactor, which is pressed against front bottom drafting roller by supra magnet without clearance. It forms together with the bottom roller an overall enclosed compression chamber whose bottom contour, the generated surface of front bottom roller, moves synchronously with the strand of fibers and transport this safely through the compactor.



According to Stahlecker , RoCoS 1 is suitable for 100 % cotton, cotton blends and 100% synthetic fibers with maximum staple length of 60 mm. RoCoS 2 is suitable for 100% wool,100 synthetic and wool/synthetic blends having minimum staple length of 50 mm. As RoCoS does not requiring air suction, air piping, perforated drums or apron and therefore there is no extra power and maintenance is necessary.

Advantages of compact spinning:

Improvement in tensile properties, reduced hairiness as well as improved regularity of a yarn is the key benefits of compact spinning. Here some of the advantages of compact spinning are discussed.

Advantages in spinning:

1. As maximum number of fibers is integrated into yarn body during spinning, so better utilization of fibers at the same time less fly generation and clean atmosphere is spinning department.
2. Yarn twist can be reduced by 10% while maintaining the same strength as the conventional ring yarn. Therefore, it is possible to increase the machine speed which ultimately results into increased production.
3. The weak point in the spinning zone (spinning triangle) is eliminated, the end breakage rate is considerably reduced which again leading to higher machine efficiency.
4. Increased strength and breaking elongation of yarn due to less protruding fibers and improved orientation of fibers, which leads to full realization of fiber strength.
5. Appreciable reduction in hairiness due to virtually elimination of spinning triangle.
6. Less expensive raw material can be used to produce good quality yarn.
7. Significant reduction in IPI, results better yarn quality.
8. Singeing can be completely eliminated.
9. Noil % at comber can be reduced as short fibers are better integrated into yarn body during spinning.
10. The improved characteristics of compact yarns give higher yarn sales price.

Advantages in winding:

- Due to end breaks in spinning, improved winding efficiency as few clearer cuts.
- Waxing of yarn can be eliminated.

Advantages in twisting:

- Lower twist can be employed in doubling, to improve the strength of yarn.
- The systems like COM4twin, Elitwist saves the cost of doubling.

Advantages in weaving preparation & weaving:

1. Better packing density of compact yarn gives better abrasion resistance and which leads to fewer end breaks in weaving. Also loom shed droppings and linting in knitting are reduced.
2. Degree of sizing can be reduced which reduces the sizing cost and the subsequent desizing cost.
3. Reduced end breaks in warping improve efficiency of warping.
4. Low end breaks in weaving improve weaving machine efficiency.
5. The compact spun yarn gives clearer cut contours in design.

Disadvantages of compact spinning:

→ Higher capital cost of the machine due additional condensing zone in drafting system.
→ Increased maintenance of condensing zone which adds to cost.

Conclusion:

Present review is taken to understand the root causes which are influencing the major yarn characteristics on conventional ring frame. Many researcher's and industrialists have already shown the improvements in yarn characteristics and thereby improvement in subsequent process efficiency by adoption of compact spinning technology. However, despite of few disadvantages the compact spinning system can be a system of future.

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