To Improve the Productivity of Ring Frame

Image Courtesy: http://i00.i.aliimg.com

By:

Nilesh P. Patil,
P. P. Raichurkar,
Arun Karmudi,
M. S. Anjane &
R. D. Parsi

To Improve the Productivity of Ring Frame

By: Nilesh P. Patil, P. P. Raichurkar, Arun Karmudi, M. S. Anjane & R. D. Parsi

The authors are associated with the Centre for textile functions (CTF), NMIMS MPSTME Shirpur campus, Shirpur, Dist- Dhule, Maharashtra

1. Abstract

This project deals the study of maximum utilization of machine to improve the machine efficiency and machine efficiency is defined as the ratio, expressed as a percentage of the actual production per shift to the maximum possible production, if each spindle has work continuously for the entire duration of the shift. Even under ideal circumstances, certain losses in efficiency would be inevitable, and these must be allowed for when judging the extent of control exercised by a mill on machine efficiency. The Machine Efficiency Index (MEI) provides a convenient way of doing this.

This project study is taken for 2 different counts – 9 combed wool and 24 carded count. Results are collected of before and after implementation of remedial measures.

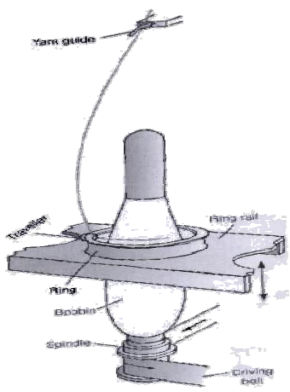
Key factors: – *End breakage rate, Idle percentage, Doffing loss percentage Pneumafill, Waste percentage.*

2. Introduction

Ring spinning has been in existence since its introduction by an American, John Thorpe in 1828 and then Jenks developed the traveler that rotated on the ring. These two steps opened the door to our current ring spinning technology that is the standard of yarn manufacture. Other spinning technologies have been developed that are higher in productivity, but are lacking in many aspects of the yarns desirable characteristics.

Ring spun yarn has retained its position as the system that produces the strongest, finest, softest and most lustrous yarn and fabric. To spin high quality yarn at high spindle speeds the fibre and its preparation have to be controlled to high standards. The ring frame cannot spin superior yarn from inferior material or roving.

3. Review of Literature:-



3.3 Ring spindle

Ring Spinning Frame **Ring spindle**

- The ring spinning will continue to be the most widely used form of spinning machine in the near future, because it exhibits significant advantages in comparison with the new spinning processes.

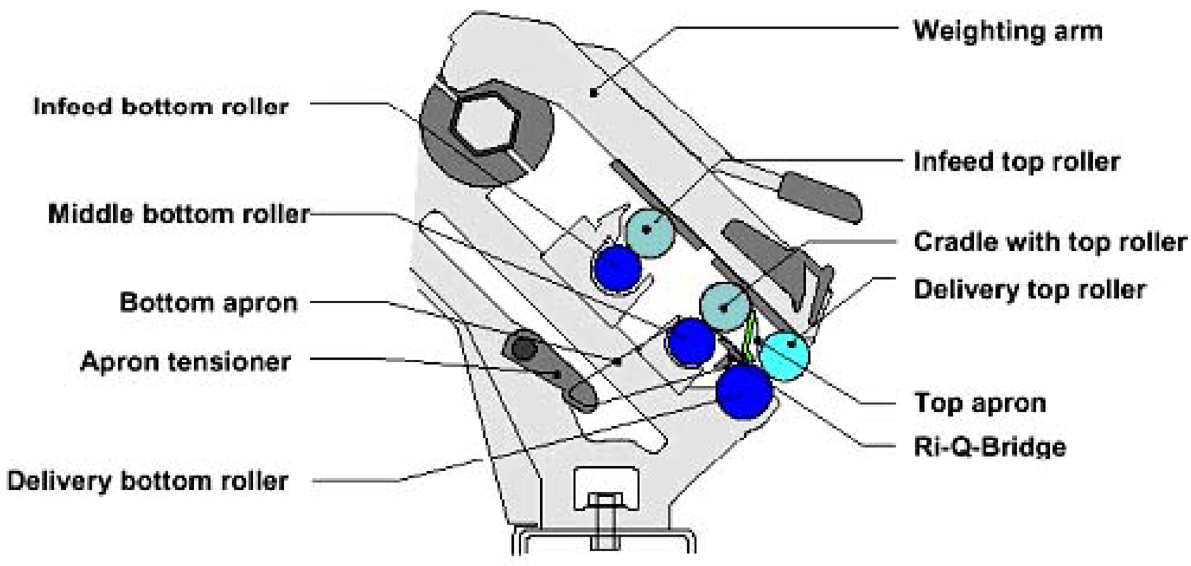
Following are the advantages of ring spinning frame,

- It is universally applicable, i.e. any material can be spun to any required count
- It delivers a material with optimum characteristics, especially with regard to structure and strength.
- it is simple and easy to master
- the know-how is well established and accessible for everyone

Functions of ring frame-

- to draft the roving until the required fineness is achieved,
- to impart strength to the fibre, by inserting twist
- to wind up the twisted strand (yarn) in a form suitable for storage, transportation and further processing.

3.1 Drafting zone:-



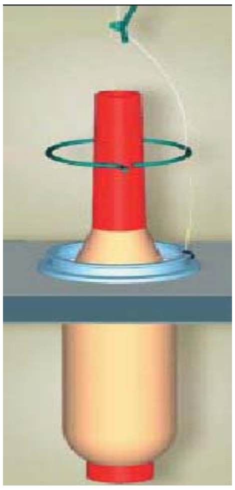
Drafting system

Drafting arrangement is the most important part of the machine. It influences mainly evenness and strength. The following points are therefore very important,

- drafting type
- design of drafting system
- drafting settings

- selection of drafting elements like cots, aprons, travelers etc.,
- choice of appropriate draft
- service and maintenance
- Drafting arrangement influence the economics of the machine - directly by affecting the end break rate and indirectly by the maximum draft possible.
- If higher drafts can be used with a drafting arrangement, then coarser roving can be used as a feeding material. This results in higher production rate at the roving frame and thus reducing the number roving machines required, space, personnel and so on.
- In fact increase in draft affects the yarn quality beyond certain limit. Within the limit some studies show that increase in draft improves yarn quality.

3.2 Twisting Zone:-



Twisting of yarn

- Traveler imparts twist to the yarn. Traveler and spindle together help to wind the yarn on the bobbin. Length wound up on the bobbin corresponds to the difference in peripheral speeds of the spindle and traveler. The difference in speed should correspond to length delivered at the front rollers. Since traveler does not have a drive on its own but is dragged along behind by the spindle.
- High contact pressure (up to 35 N/square mm) is generated between the ring and the traveler during winding, mainly due to centrifugal force. This pressure leads to generation of heat. Low mass of the traveler does not permit dissipation of the generated heat in the short time available. As a result the operating speed of the traveler is limited.
- When the spindle speed is increased, the friction work between ring and traveler (hence the build up) increases as the 3rd power of the spindle rpm. Consequently if the spindle speed is too high, the traveler sustains thermal damage and fails. This speed restriction is felt particularly when spinning cotton yarns of relatively high strength.
- If the traveler speed is raised beyond normal levels, the thermal stress limit of the traveler is exceeded; a drastic change in the wear behavior of the ring and traveler ensues. Owing to the strongly increased adhesion forces between ring and traveler, winding takes place between the two. These seizures inflict massive damage not only to the traveler but to the ring as well. Due to this

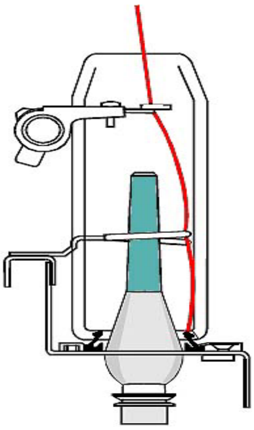
unstable behavior of the ring and traveler system the wear is at least an order of magnitude higher than during the stable phase. The traveler temperature reaches 400 to 500 degrees Celsius and the danger of the traveler annealing and failing is very great.

3.3 Winding zone: - The vast majority of bobbins are wound with the "filling" (cop) build. The bobbin is formed in three parts:

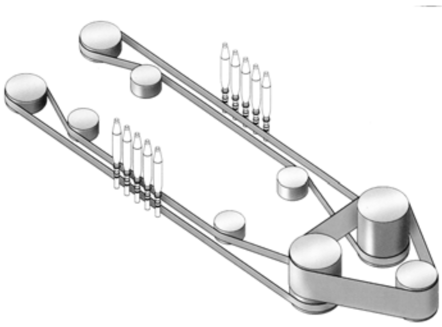
- the curved base,
- the cylindrical body and
- The conical top.

The winding procedure is:

- The ring rail is raised slowly to "wind" the yarn and is then moved downward at a higher speed to lay coils at an increased helix angle to lock-in the previous layer.
- The upward and downward movement is referred to as the stroke.
- The height of the stroke is normally about 15 to 20% greater than the diameter of the ring.
- The downward movement of the ring rail is 2 to 3 times faster than the upward movement.
- The combination of the two layers having different winding angles is beneficial in the stability of the build in the re-winding process.
- Occasionally the spinning ends down will be higher during the faster downward movement and should be considered in setting up the speeds and conditions of the machine.
- The stroke is short at the beginning of the build and is increased throughout the formation of the curved base. After the base formation the stroke length remains constant.



Winding of yarn on bobbin



Tangential spindle drive system

3.4 Spinning Geometry: - From Roving bobbin to cop, the fibre strand passes through drafting arrangement, thread guide, balloon control rings and traveler. These parts are arranged at various angles and distances relative to each other. The distances and angles together are referred to as the spinning geometry, has a significant influence on the spinning operation and the resulting yarn. They are,

- yarn tension

- number of end breaks
- yarn irregularity
- binding-in of the fibres
- yarn hairiness
- Generation of fly etc.

3.5 Spinning Triangle:-Twist in a yarn is generated at the traveler and travel against the direction of yarn movement to the front roller. Twist must run back as close as possible to the nip of the rollers, but it never penetrates completely to the nip because, after leaving the rollers, the fibres first have to be diverted inwards and wrapped around each other. There is always a triangular bundle of fibres without twist at the exit of the rollers; this is called as SPINNING TRIANGLE.

Most of the end breaks originate at this point. The length of the spinning triangle depends upon the spinning geometry and upon the twist level in the yarn. The top roller is always shifted 3 to 6 mm forward compared to bottom roller. This is called top roller overhang. This gives smoother running and smaller spinning triangle. The overhang must not be made too large, as the distance from the opening of the aprons to the roller nip line becomes too long resulting in poorer fibre control and increased yarn irregularity. Continuous variation of the operating conditions arises during winding of a cop. The result is that the tensile force exerted on yarn must be much higher during winding on the bare tube than during winding on the full cop, because of the difference in the angle of attack of the yarn on the traveler. When the ring rail is at the upper end of its stroke, in spinning onto the tube, the yarn tension is substantially higher than when the ring rail is at its lowermost position. This can be observed easily in the balloon on any ring spinning machine. The tube and ring diameters must have a minimum ratio, between approx. 1:2 and 1:2.2, in order to ensure that the yarn tension oscillations do not become too great. Yarn tension in the balloon is the tension which finally penetrates almost to the spinning triangle and which is responsible for the greater part of the thread breaks. It is reduced to a very small degree by the deviation of the yarn at the thread guide. Equilibrium of forces must be obtained between the yarn tension and balloon tension.

4. Experimental Plan

4.1 Material and Methods: -

Medium grade cotton was used in the study. The cotton fibres were processed through a blow room, carding and one passage of draw frame as breaker, unilap, comber & one passage post comb draw frame as finisher.

The specification of the cotton which was used in the study is as follows:

Effective Length	31mm S - 6 (Shankar-6)
Bundle Strength	24.5(gm/tex)
Micronaire	4.2 gm/cc
Trash content	2.5%
Short fiber percentage	2.8%

Raw material properties

In this experiment, trials were conducted at ring frame considering various factors which are directly affected to the ring frame productivity, such as End breakage rate, Idle %, Doffing loss % and Pneumafill waste %. The project study is taken for 2 different counts – 9 combed wool and 24 carded count. For all trials, the Ring Frame machine (Zinser Model E-321) with a Speed of 9800 and 15500rpm is used respectively for both counts. The details of machinery parameter which are selected for study.

4.1.1 Details of samples: -

Machine	**9 combed wool**	**24 carded count**
Carding	140 mts/min	100 mts/min
Draw frame(Breaker)	550 mts/min	550 mts/min
Unilap	120 mts/min	-
Comber	160 mts/min	-
Draw frame(Finisher)	450 mts/min	450 mts/min
Roving frame	950 rpm	1050 rpm
Ring frame	9800 rpm	15500 rpm

Machine speeds

4.1.2 Technical specification for Ring frame machine: -

Ring frame No.	4	9
Count	9 combed wool	24 carded
Roving hank	0.4	0.6
Break draft	1.3	1.3
Spacer colour	Black	White
Spacer size	3.8mm	2.8mm
TM/TPI	4.0/14.4	4.0/20.58
Traveller no.	4 Bracker	2/0 Bracker
Traveler profile	U 1 CS UDR	C 1 MM UDR
Traveler clearer guage	3.3	2.3mm
Bottom roll setting	44/60mm	44/60mm
Saddle guage	48/58mm	48/58mm

Top arm loading color	Red	Red
Top arm loading weight(kgs)	15 Kgs	18 Kgs
Cops color	Violet	Mehendi
Cops length	230mm	230mm
Taper	1:40	1:40
Wharve diameter	20.5mm	20.5mm
Ring diameter	44mm	42mm
Ring type	R&F	Bracker Titan
Chase length	42mm	46mm
Winding length	4.5mm	4.5mm
Pitch of the yarn	3.46mm	3.46mm
No. of spindles	1136	1136
Lift	205mm	205mm
Bobbin length	230mm	230mm
Spindle guage	70mm	70mm
Spindle tape drive	Tangential Belt drive	Tangential Belt drive

Technical specification for Ring frame machine

4.2 Plan of Work

Study taken for 2 different counts

9 combed wool

24 carded

Study of target efficiency

Study of loss (Breakup)

1) End breakage rate

2) Idle spindle %

3) Doffing loss %

4) Pneumafill waste %

↓

Assessment and compare with norms

↓

Technical factor, work practices taken in consideration for maximize the Ring Frame efficiency

↓

Study of comparative aspects of before and after implementation of technical factors,

work practices

↓

Standardize the breakup of loss

↓

Conclusion

↓

Outcome of project work

5. Results and Discussion

5.1 Final Results

5.1.1 For 9 combed wool:-

Factors	**Before**	**After**	**% improve**
1)End breakage rate (breaks/100spdl/hour)	4.01	3.27	18.45
2)Idle spindle % (including missing spdl)	2.11	1.23	41.70
3)Pneumafill waste %	2.97	2.4	19.19
4) Doffing loss %	1.23*7 doff =8.61	1.02*7doff =7.14	17.07
5)R/F efficiency loss %	13.69	10.77	21.32
6)R/F efficiency %	**86.31**	**89.23**	**2.92**

Result For 9 combed wool

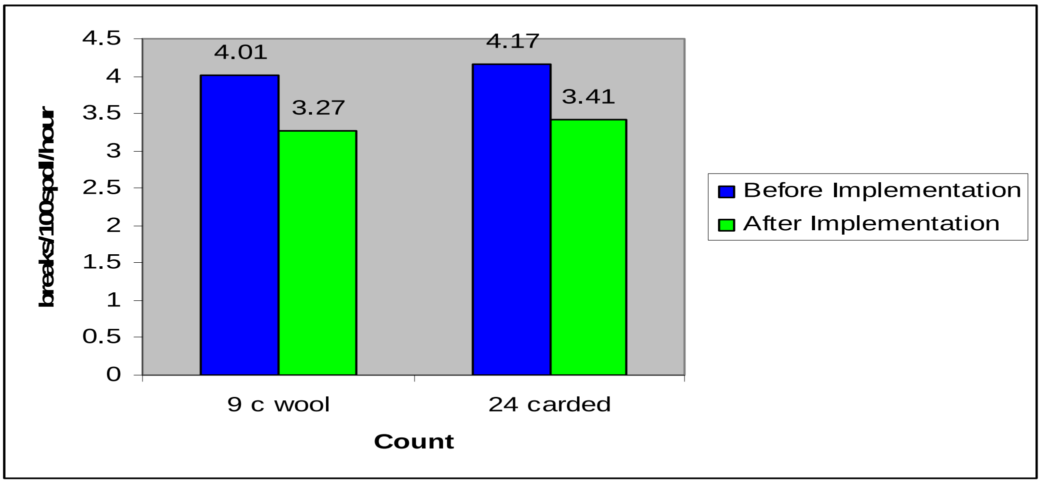
5.1.2 For 24 carded count:-

Factors	Before	After	% improve
1)End breakage rate (breaks/100spdl/hour)	4.17	3.41	18.22
2)Idle spindle % (including missing spdl)	2.81	1.93	31.31
3)Pneumafill waste %	2.87	2.52	12.19
4)Doffing loss %	1.30*3 doff =3.90	1.11*3 doff =3.33	14.61
5)R/F efficiency loss %	9.58	7.78	18.78
6)R/F efficiency %	**90.42**	**92.22**	**1.8**

Result For 24 carded count

5.2 Project Trends

5.2.1 End Breakage Study :-

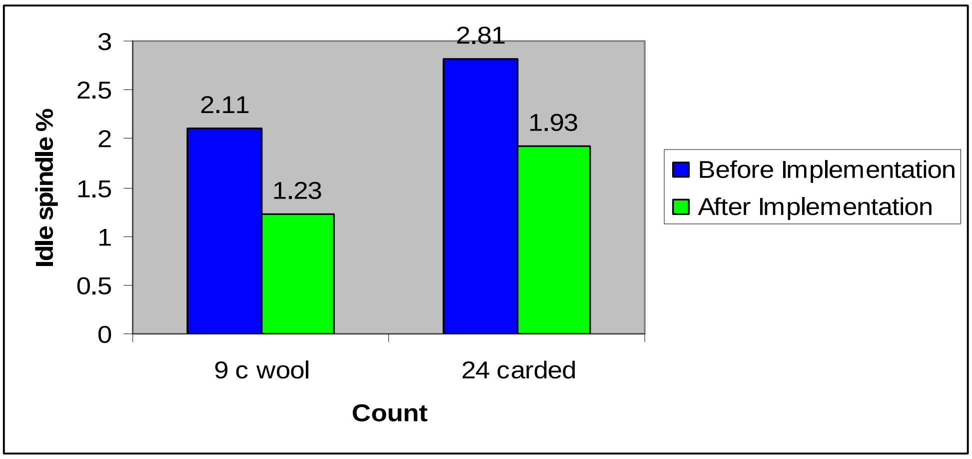


(Breaks/100spdl/hour)

End Breakage Study :- (Breaks/100spdl/hour)

To improve the productivity of Ring for 9 combed wool and 24 carded count the obtained results was breaks/100spdl/hour plotted in Figure no. 1a against the counts. Figure no 1a clearly indicated that breaks/100spdl/hour was reduces after implementing the remedial measures.

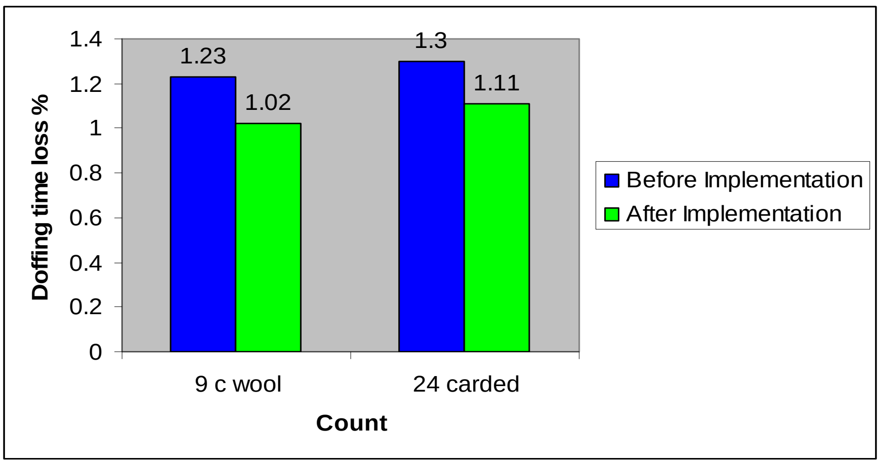
5.2.2 Idle Spindle Study :- (idle spindle percentage)



Idle Spindle Study :- (idle spindle percentage)

To improve the productivity of Ring for 9 combed wool and 24 carded count the obtained results was idle spindle percentage plotted in Figure no. 2a against the counts. Figure no 2a clearly indicated that idle spindle percentage was reduces after implementing the remedial measures.

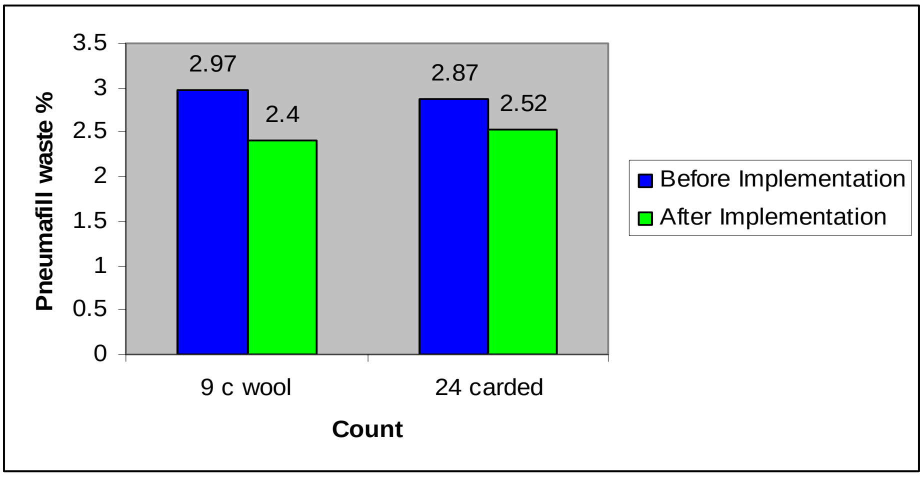
5.2.3 Doffing Time Loss Study :- (doffing time loss percentage)



Doffing Time Loss Study :- (doffing time loss percentage)

To improve the productivity of Ring for 9 combed wool and 24 carded count the obtained results was doffing time loss percentage plotted in Figure no. 3a against the counts. Figure no 3b a clearly indicated that doffing time loss percentage was reduces after implementing the remedial measures.

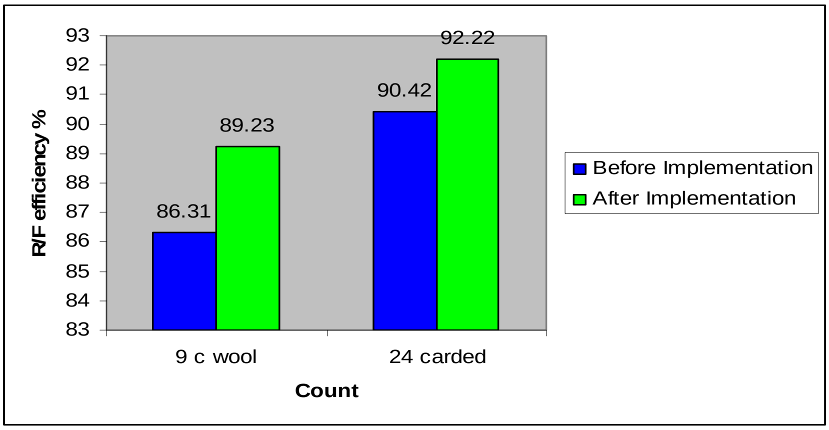
5.2.4 Pneumafill Waste Study: - (pneumafill waste percentage)



Pneumafill Waste Study: - (pneumafill waste percentage)

To improve the productivity of Ring for 9 combed wool and 24 carded count the obtained results was pneumafill waste percentage plotted in Figure no. 4a against the counts. Figure no 4a a clearly indicated that pneumafill waste percentage was reduces after implementing the remedial measures.

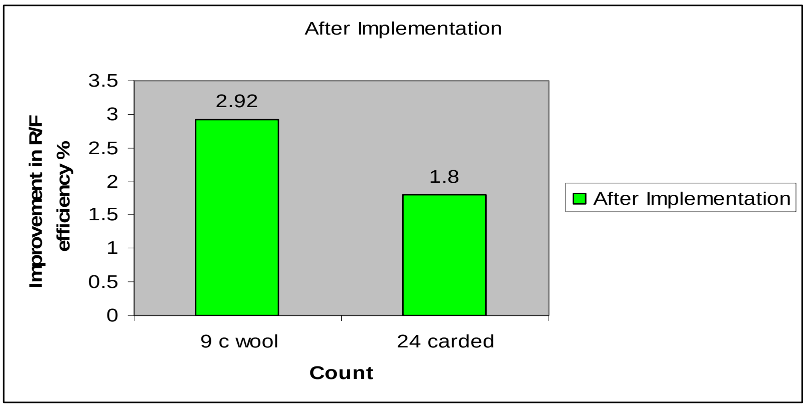
5.2.5 Ring frame efficiency %:- (Ring frame efficiency percentage)



Ring frame efficiency percentage

To improve the productivity of Ring for 9 combed wool and 24 carded count the obtained results was Ring frame efficiency percentage plotted in Figure no. 5a against the counts. Figure no 5a a clearly indicated that Ring frame efficiency percentage is increases after implementing the remedial measures.

4.2.6 Improvement in R/F efficiency %:- (improvement in Ring frame efficiency percentage)



Improvement in Ring frame efficiency percentage

To improve the productivity of Ring for 9 combed wool and 24 carded count the obtained results was improvement in Ring frame efficiency percentage plotted in Figure no. 6a against the counts. Figure no 6a a clearly indicated that Ring frame efficiency percentage is increases after implementing the remedial measures by 2.92 and 1.8 percentage respectively.

6. Conclusion

In case of 9 combed wool and 24 carded counts efficiency losses are reduces and efficiency increases by 2.92 & 1.8 % respectively after implementing the remedial measures. It is concluded that for both count implementation of remedial measures gives better efficiency result.

Result:-

Count	**Efficiency improved %**
1) 9 combed wool	2.92
2) 24 carded count	1.8

7. References:-

1) Process control in spinning by ATIRA
2) Technology Handbook (Edition2006) RIETER.
3) A. R .Khare, Elements of Ring frame and Doubling
4) W.Klein, A Practical Guide to Ring Spinning (Volume 4)
5) Precitex handbook of cots and apron.