Modern Trends In The Design Of Spinning Machinery To Produce Quality Yarn

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Abstract- *The design of spinning machineries has undergone vast changes over the years. Intensive Beating elements are replaced by pin type beaters for better cleaning efficiency with less Waste level. Aero dynamics, automation, online monitoring systems, on line quality Monitoring revolutionized the concepts of spinning machines design. Speeds and production level have also increased significantly. Here, the criteria for machinery design, factors influencing quality of yarn, important developments in spinning machineries from blow room to ring frame are discussed.*

Keywords- Aerodynamic cleaning, Blow room, Card, Draw frame, Speed frame, Ring frame, Auto levelers.

I. INTRODUCTION

As anyone knows, the prerequisite for a good fabric is a good yarn, and the prerequisite for a good yarn is a good preparation, and also good raw material. Today good yarn is more measurable in terms of faults and quality and with advancements in the testing methods and instrumentation technology; quality is the prime word in the textile industry right from the selection of raw material to the final dispatch of yarn. It is the decade of ISO quality systems and today every spinning mill is preparing itself to achieve these feet.

The art of spinning is aimed at the best possible utilization of existing raw-material and as many of us will agree, we have practically very little control over the quality of natural raw-material called cotton, and it is the efforts of each spinner to make the most of the raw material and not to waste the resources and also to achieve the best quality possible. Today the requirement is to produce a total fault free yarn and this can be achieved in a well calculated and controlled manner through Total Quality Management (TQM).

There exist many factors that influence quality and I would like to mention here 5 important ones:

1.1Knowledge

Here, I mean the know-how of spinning technology. India is a classical cotton growing country with a long tradition of spinning. There exists plenty of sound knowledge in the area of spinning, especially with long staple

1.2. Raw-Material

The spinning industry is the one, unlike others, has the raw material which is the most variable in quality and nature and every spinner needs to tune himself to the variations found in the raw-material while attempting to achieve a more standard product called yarn. India has almost every possible cotton quality available from local growing areas i.e. from coarse, short stapled Deshi cottons from Punjab to the finest extra-long staples like Suvin, from Tamilnadu. This wide range offers suitable cotton for each yarn fineness and application. Every mill has its own choice of raw-material according to their economics.

1.3. Testing Instruments

The advancements in the textile instrumentation and testing instrumentation technology have really helped today's spinner to effectively achieve a fault-free yarn. An effective quality management can be achieved only through proper standards and testing, and the testing methods and equipment is more or less standardized worldwide. Today in the testing area, there is a new trend to go in for 'on-line monitoring' on the production machines compared to the random laboratory testing methods.

1.4. Analysis

The modern testing equipment provides enormous data and it is must to evaluate and interpret the test values for possible improvements in processes. Today, the analytical and interpretation capacity of test results has reached higher degrees, so as to precisely eliminate faults on a permanent basis.

1.5. Machinery

The basic pre-requisite however, for a high-quality standard starts from a good process machinery and the advancements in the machinery design over the decades have really imparted the spinning industry with necessary capability to spin a fault-free yarn.

As per the topic, we shall more deal in this paper about the modern trends in the design of the spinning machinery, helpful in producing a better quality yarn free from faults. Like any other industry, quality and productivity need to be raised to higher levels on a continuing basis and certainly, the maximum

contribution has to come only from the trends in the machinery design.

If' we go through the evolution of technology in all spheres, it would be understood that the rate at which the evolution in technology is happening today is very high compared to same which happened 300 years back when Mr.Carnot invented utilization of steam energy in the 17th century, which triggered the industrial revolution.

II. INFUENCE OF RAW MATERIAL ON SPINNING MACHINERY DESIGN

2.1Definition of Quality

Quality is the one, which is measurable in specific terms, but it should be understood that the same is permanently changing. With the developments in all the five factors as mentioned above, the level of quality is always on the rise, and what was the best quality yesterday, no more can be considered to be a good quality tomorrow. The long-term changes in the quality are very high and if you refer to the figure (1) and (2), it would be possible for one to understand the changes.

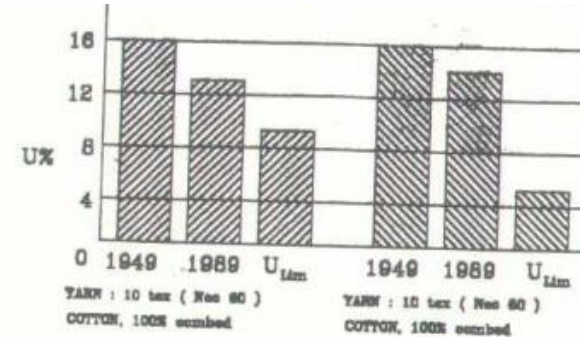

Figure 1: Improvements of Yarn Evenness Since 1949

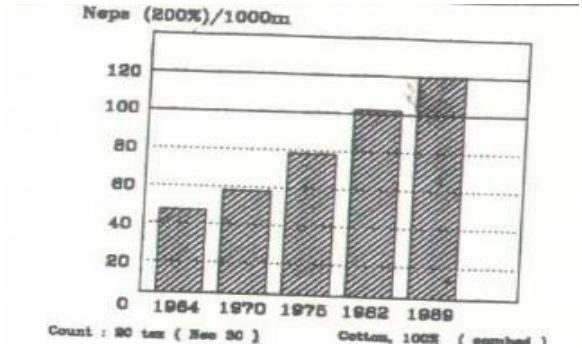

Figure 2: Number of Neps in Combed Cotton

If the task is to produce 'fault-free yarn' and to design the machinery features to achieve theSame, then it is necessary to study the following three aspects of our spinning technology:

a. Variations in raw material (esp. cotton)
b. Quantitative utilization of material
c. Qualitative utilization of material

A knowledge on the above three aspects only has set the various trends in machinery design over the years.

2.2Variations in Raw Material (Cotton)

From 1949 until today the cotton yarns have improved by approximately 3% C.V. (Uster) . The reasons for this improvement are , a shortened production process, improved draw frame technology, satisfactory operating regulation or leveling devices in cards and draw frames and better drafting systems. Measurement technology for reporting the nep content are available only since 1960 and from the graph in figure (2), you can see a clear decrease in the cotton yarn quality in recent years. Even more refined technologies and more precise machinery could not stop this deterioration. The quality of raw cotton had been reduced too much by harvest mechanization and improper practices in ginning and packing. The above are worldwide practices prevailing and Indian raw-material is not an exception, even though, we are better in view of roller ginning followed in the industry. Another aspect of the raw-material quality is the increased seed trash particles which make the job of spinner to be difficult.

The seed coats, the immaturity, the fineness, the wax content and the honeydew are posing great problems to today's machinery designer to refine the machine for achieving a fault-free yarn. The increase in seed coats also results in the reduction in the particle size, and the average particle size has slightly decreased during the last few years as given in figure (3a&b), which results in increase of the faults.

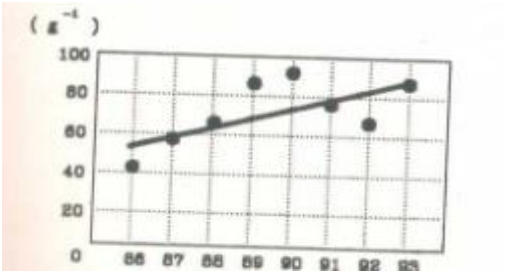

Figure 3(a): Increase in Seed Trash Particles

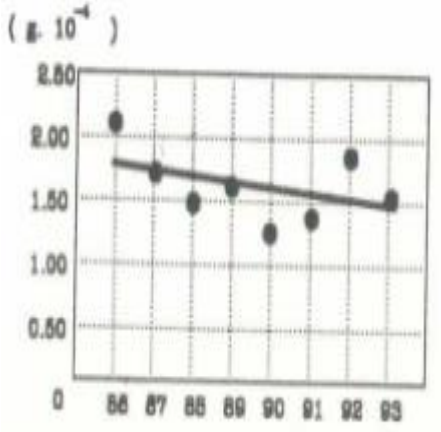

Figure 3(b): Reduction in Particle Weight

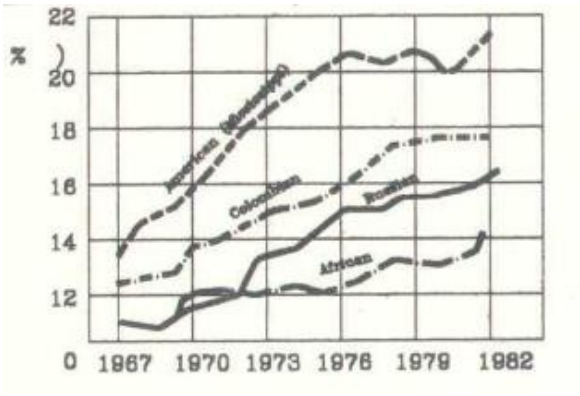

Figure 4: Increase in Short Fiber Content

Figure 5: Factors that Influence Cleaning Efficiency

Another important aspect of quality is the trend in increase in short fiber content worldwide as given in figure (4), which also poses a lot of difficulties. The effects of all the above negative factors in raw-material quality have a lot of bearing on the final yarn quality, and it is the efforts of the machinery designers in association with the knowledgeable spinners worldwide to continuously upgrade the machinery features which enable achieve still better yarn quality in the long run.

2.3Quantitative Utilization of Material

The first objective is to produce as much as yarn out of available material as possible. The waste is to be minimized at the various processing stages and on the other hand, highest possible cleaning should be aimed for in the blow room and the cards, this is only possible with according waste quantities referred in figure (5).

Here, it is the responsibility of the quality management to find the ideal compromise between these contradictory trends. To achieve this, three conditions should be satisfied for optimization

I. The qualitative and quantitative waste and fiber length analysis
2. Easy influence on waste at the machine
3. Avoiding loss of good fibers through the process.

Whilst the analysis can well be made by collection of waste, it is the machinery design which influences the smooth separation of waste from the fibers. The cleaning efficiency can only be influenced in a certain area by a larger quantity of waste. Higher degrees of cleaning can then only be achieved with excessive waste values. An insignificantly improved cleaning would result in inefficient production as shown in figure (6). It is important to optimize the waste quantity with highest possible cleaning efficiency, because it influences production efficiency in a decisive way. We know from experience that saving of 1% to 1.5% on raw-material is possible by the above. If you consider 1% saving by extra realization, for an annual output of 5000 tons, there could be a net saving of approximately Rs.90 Lakhs per year, which is recurring (Refer Fig. 7&8)

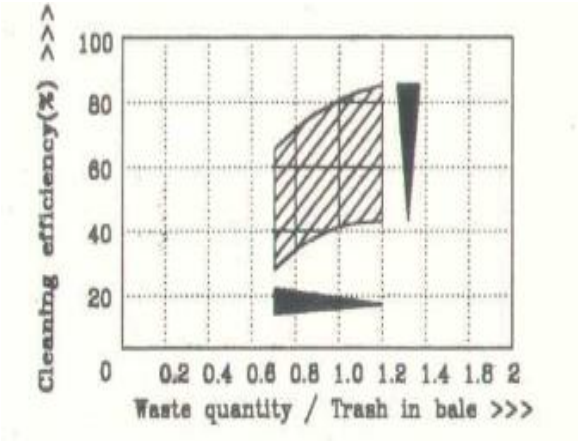

Figure 5: Factors that Influence Cleaning Efficiency

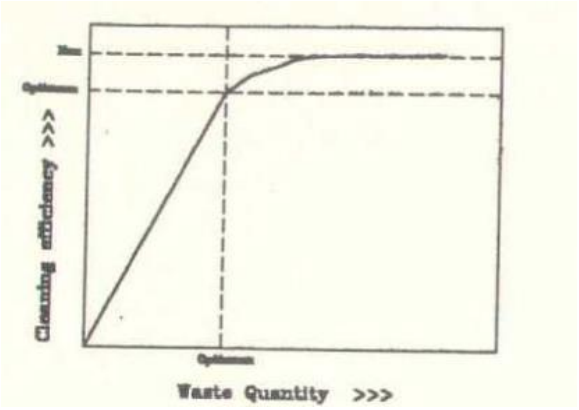

Figure 6: Optimization of Waste Quantity

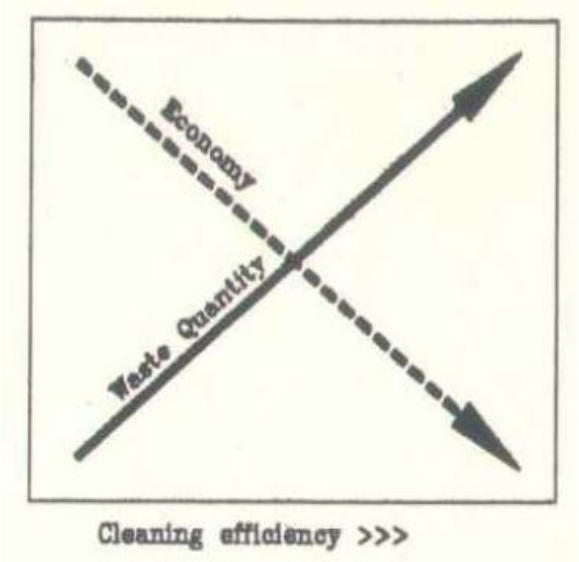

Figure 7: Optimization of Waste Quantities

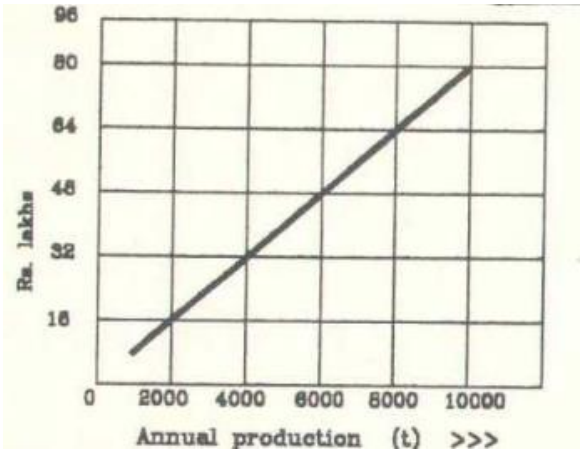

Figure 8: Annual Savings Through 1% of Waste Reduction

2.4Qualitative Utilization of Material

Another aspect of machinery design aims at qualitative material utilization and the process should be in optimum condition at all levels. So that we achieve the best quality possible, for this a lot of criteria need to observe.

- Mixing Consistency
- Residual trash condition
- Dust contents
- Number and size of NEPS
- slivers/Yarn count variation
- Evenness of process material
- Fault in output material

These parameters are influential to different &graces at different stages of processing As all of our know, the mixing consistency helps in fretting a name homogeneous and even yarn The residual trash influences the running behavior and cleaning efficiency until the last stage and also amounts to the generation of nets The presence of dust also creates a lot of practical problems apart from contributing to the wear of the machine elements.

	Cleaning line	Card	Draw frame	Comber	Simplex	Ringframe
Mixing consistency	X					
Residual trash content	X	X		X		
Dust content	X	X	X			
Short fibre content		X		X		
Neps		X		X		
Count variation		X	X		X	X
Evenness		X	X		X	X
Imperfection & Random faults		X	X	X	X	X

Figure 9: Influence of Spinning Machine in Different Quality Parameters

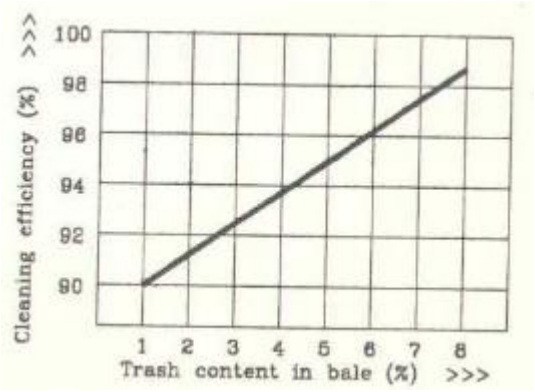

Figure 10: Cleaning Efficiency vs Trash content value

The amount of NEPS decisively determines the yarn quality and the nep production and removal in the process depend on many factors. The evenness, count variation and yarn faults are to be controlled throughout the process and many factors influence the same.

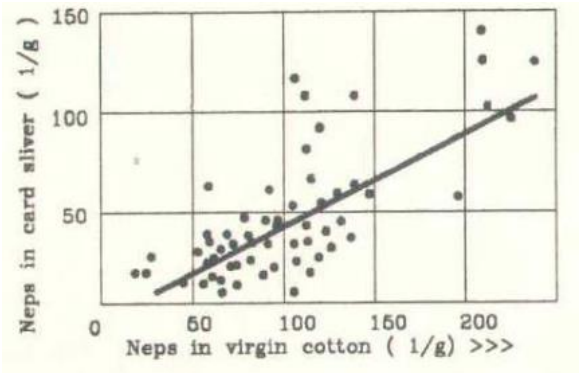

Figure 11: NEPS in Card Sliver in relation to be NEPS in Virgin Cotton

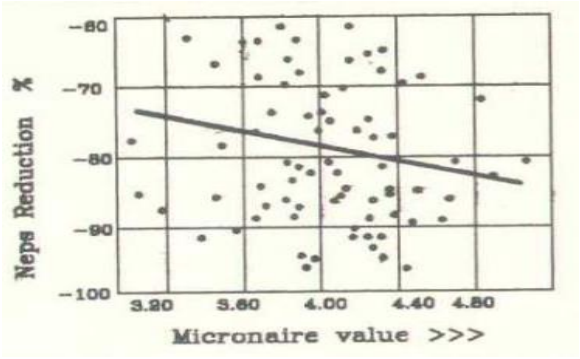

Figure 12: NEP Reduction by the Card

2.5Criteria for Machinery Design

Having explained the above, with the availability of various testing instruments, methods, procedural analysis and interpretation, it is possible for today's spinner to overcome the above-negative factors in the best possible way and spin yarn

of optimum quality effectively utilizing the raw-material with a least waste.

From the above, one would easily understand that the trends in machinery design should satisfy the following criteria specifically for the optimum spinning of raw material:

1. To take care of the varying quality of raw-material
To achieve the maximum realization of fibers with minimum lint lost in the waste.
To have the minimum waste extracted with, but effectively to remove all the trash present to achieve maximum cleaning.
4. To reduce the short fiber content more effectively, so that final yarn quality is better.
5. To handle the fibers more gently, so that fiber ruptures and curling is avoided and achieves higher yarn strength.
6. To achieve even and parallel distribution of the fibers throughout the process so as to achieve the best uniformity and reduce variations.

If the task of the machinery designer is to achieve the above, now we shall go in detail about the various aspects of machinery designs at different levels of processes which have helped in achieving the same.

III. DEVELOPMENTS IN DESIGN FEATURES OF SPINNING PREPARATORY MACHINES

3.1 Blow Room

The development of blow room had undergone a lot of changes and improvements, and today's modem blow room is totally different from the earlier types.

Until 1940, the concept was to have a double process system with no place for good condensers or openers. The concept is to beat the cotton heavily with big strikers, so that the trash and dust are well liberated. It was possible to achieve good cleaning by the above process, but only at the cost of higher percentage of waste removal and fiber damage. The bale openers were small and did not provide good blending possibilities. Simple mechanical regulation systems were there, by which good evenness could not be achieved.

But today's concept is to smoothly handle the fibers and to aim for tuft reduction right from the beginning stage of the process with machines like, Blend mat. In the next stage, it is to just loosely treat cottons in machines like Axilla Cleaners or Mono Cylinder Cleaners instead of beating with gripped beaters against grid bars.

Departing from the conventional beaters, big beaters of 24" or 36" dia, like Porcupine Opener or Striker Cleaners, the next generation of Striker Cleaners, Pintype Cleaners and Saw tooth Cleaners working in conjunction with mote-knives, carding segments and with or without grid bars has helped in better treatment of the stock effectively retrieving maximum spin able fibers. The beaters were small in diameter with strikers of shorter height which will help in better control of the fibers in the machine. However, today's concept is to go for only pin or needle type rollers as well as fine saw tooth rollers, running at high speeds, against mote-knives and combing segments, so that the fibers and trash are effectively separated from one another under the influence of high air currents generated and also with good air separation principles, the lint alone is retrieved.

The Truetzschler Cleanomat series of cleaning equipment help in achieving the new concept more effectively, and the above kind of treatment ensures the optimum ways of operation with minimum lint lost, and also enables achieve maximum cleaning without fiber damage.

This is the first step as any one knows in achieving the better quality yarn. Another important aspect is the dust removal which is predominantly effective in the new generation blow room machines. With the elimination of dust to a great extent in blow room as well as in cards, the fiber stock could be worked at very high speeds in the subsequent machines.

Today, good dust evacuation and filter systems are available, so that the department works dust free, thus providing ambient working condition for the workers. The electrical and electronic controls like usage of photo cell, pressure switches, and D.C./Servo drives ensure the even materialflow right through the process, and the gradual and uniform reduction of the material size to achieve the fine and even sliver at the card.

The usage of scutcher system is fading away and with the development of effective chute feeding systems to the cards, the handling of the fibers are better controlled in achieving better quality. The present double stage feeding to the cards, as effectively done by Exacta feed FBK of Truetzschler ensures the smooth, uninterrupted and controlled transfer of material from blow room to the cards.

Another concept is the continuous feeding, `Contifeed System' which ensures that the flow of material from blow room is suitably adjusted according to the requirement of card. The usage of PIV and D.C./Servo drives ensure the controlled material flow enabling achieve uniform feeding to the subsequent machinery.

3.2 Cards

The ageold say, "Card well to Spin well" still holds good and in the recent decades more thrust is set on carding technology whilst better conditions reached the speed frames and ring frames a little earlier. The objective of carding as given below still remains the same and the modern cards only ensure these objectives are fulfilled in more precise manner.

- Carding of fibers i.e. individualization of fibers.
- Cleaning of fibers as the last cleaning point in the process.
- Short fiber removal and to effectively improve the spinning length of the fiber stock.

The carding machine to begin with started as a roller and clearer card, where the objectives were carried out in a very primitive way and the production and quality is not consistent and continuous. The next generation gave in for the revolving flat cards which helped the spinner to have an improved continuous working. However, the flexible card clothing at that time was not providing the consistent quality continuously. The arrival of metallic card clothing had set the development of carding process to greater heights and the subsequent generation of cards aimed at meeting the objectives more effectively, simultaneously looking for the very high production and quality. The new generation card today has totally departed from the conventional machine, and I would like to mention few points about the different areas of a carding machine:

Comparing to the normal feeding, the feed plate has been redesigned for a better controlled smoother feeding of fibers to the licker-in. The licker-in clothing has been improved for better effective opening of the fibers. The conventional mote-knives and grids have been replaced by better mote-knives and combing segments along with positive suction, which ensures the effective removal of trashes, leaving the lint back.

Though the original cards had 40 and more working flats, it has been established that the number of flats actually required are quite less. The contraction of working flats in number has provided more free area between tickers-in and flats as well as flats and doffer. This led to the introduction of fixed flats, cleaning and suction elements like 'Web Clean' etc. The stationary flats contribute in parallelizing the in feed fibers before the carding action, thus improving the carding efficiency, so that the wastes removed are trashier and of short fibers and longer fibers are taken well with cylinder.

The suction and cleaning elements provided the effective extraction of fine trash, dust as well as short fibers like 'mouse-hair' which, otherwise may not be separated.

The latest concept is to seal the bottom of the card with suction which helps in eliminating the excess air caused by the rotation of the cylinder, and also effectively remove the trash and dust. This further aids in giving back the good fibers, which otherwise go into the waste. Accurate and close settings are possible between flats and cylinders as well as other parts of the carding machines and high engineering precision has now gone into the designing and building up of the carding machine achieving the same.

The web transfer from the doffer for a long time was only through oscillating comb and the development of direct web transfer systems resulted in achieving higher rates of production. The pressure rollers at the delivery side helped in crushing and eliminating the waste apart from producing more cohesion to the fibers to be well drawn to form a good sliver at high production rates. The coilers have undergone design changes providing uniform and uninterrupted coiling at high speeds optimizing the production. Can changer have also come into force, ensuring nonstop working.

The roll of card clothing is very vital in today's development of the carding machine and the new generation cylinder wires of 2 mm height and other wires accessories really helped in achieving the best quality by the effective removal of neps and thorough opening of the fibers.

The electronics and computers have a major role to play in today's carding machine in optimizing the working of the machine and also achieving the automatic feed leveling called `autoleveling'. Based on the requirement the long-term, medium term and short term auto levelers are fitted to the carding machine, thus regulating the smooth flow of the material, so that the uniform sliver size could be obtained.

The card is also provided with excellent suction arrangements to keep a high negative pressure inside the card helping eliminate faults due to fly and dust. The novel waste handling systems have also come into force.

With these today's modern cards are excellent engineering marvels contributing to the maximum in the process towards producing fault free yarn.

3.3 Draw Frame

The draw frames have also undergone revolutionary changes over the decades from the conventional 4 over 4

drafting working at a mere 30 to 50 mtrs./min. with 4 or 8 deliveries. Today the latest draw frames work effectively at even 800 to 900 mtrs./min. The development of draw frames has also happened in a fast manner with introduction of twin delivery machines with Hi-Drafting systems aiming at better fiber control. Stop motions found the way in the draw frames, so that the machines could run avoiding singles, thus improving the output quality.

Over the years, different configuration of drafting have been adopted by different manufacturers and more or less in the international market 4 over 3 pressure bar drafting has found its permanent solution which helps in achieving high speeds with better fiber control. Everyone knows that draw frame is the 'quality center' in the spinning mill and it is the final stage to ensure the quality before converting into yarn. It is a place the spinner constantly watches the quality. Though it is possible to have good drafting methods for achieving the quality, it is also equally necessary to correct the average weight of the sliver across the length and since 70s; the thirst for quality has demanded that the mere evenness achieved by doublings is no more sufficient.

The development of electronics has paved the way for the control of sliver weight on continuous basis and different types of auto leveling systems have also come in. The development of servo drives and the advancement in computer systems have today helped the manufacturers to get close to the total leveling of the sliver and are able to achieve the correction length even as low as 1.5 to 2.5 ems. In the practical working conditions. Further these advancements have also helped the mills in achieving consistently very low CV and U% on slivers. The contribution of testing systems right from fiber to yam has also helped mills to narrow down their quality targets. The development of sliver control systems like Uster's USC or SLIVER FOCUS of Truetzschler have helped in policing the quality and control the running of the machine within the set control limits.

The design developments have also looked into the effective suction and fly removal from the drafting zone and this has also helped today's spinners in targeting a better fault free yarn.

3.4 Combers

The textile industry is more and more looking for producing fine yarns and the role of combers is very vital in producing the best yarn.

The combing is the only process by which the spinner can upgrade the quality of the fiber stock, so as to spin a better fault free yarn. Apart from upgrading the average length of the fiber, the comber effectively helps the spinner to remove most of the faults along with the short fibers.

Considering the first generation `Nasmith' type combers running at 50 to 60 nips/min. until 1950, the design and development in combing technology has also undergone a long way, so that today's modern combers are capable of running between 300 to 360 nips/min. apart from producing very high qualities compared to the earlier models. The new combers also have design superiority in contributing to the reduction in the percentage of noil removed without sacrificing the quality.

The design development in all areas such as method of lap preparation, leveling of the feed lap at the super lap level, better controlled feeding methods, redesigning of the Nipper and Combing Zones as well as combing cycle, better suction methods, etc. have attributed to this achievement in this department. The better drafting and transportation of the combed slivers supervised by the sliver control USC further ensures the quality sliver to the spinners for achieving the quality yarn.

3.5 Speed Frames

Speed frame relatively had remained as a simple conversion machine in the entire spinning process. However with the development of pendulum drafting, it had been possible to converge the 3 passage speed frame process (slubber-inter-roving frames) into a simplified single passage `simplex' process. The conventional 3 over 3 or 4 over 4 dead weight drafting contributing to a maximum speed of 300 to J00 rpm of the spindle had now been changed into a 'simplex' process with pendulum top arm drafting effecting uniform loading in drafting and possibility of running even at speeds of 1800 rpm.

The conventional steel flyers have given way to the latest aluminum die cast flyers and also the suspended flyers and the new generation suspended flyers in speed frames are practically capable of running even at 1,500 rpm and above.

The electronics have come in controlling the bobbin build and also the better machinery designs have helped in ensuring good bobbins. The development of stop motions at all levels of passage of sliver into roving has ensured the spinner to build full and compact bobbins and helped eliminating singles. Better fly removal and clearer systems as well as development of effective suction systems and over-head cleaners have helped in improving the quality of rove to higher levels especially free from external faults.

Towards further advancement, automatic feeding of the cans as well as automatic doffing and also transfer of the full bobbins to the ring frame have affected smooth continuous working of the machine with less human supervision.

IV. DEVELOPMENTS IN DESIGN FEATURES OF SPINNING AND POST SPINNING MACHINES

4.1 Ring Spinning Frame

The ring spinning process, the oldest of the technology still continues to be the same and it appears that the ring spinning technology will continue to hold its role in the textile industryeven though other methods of yarn preparation such as open end spinning and air jet spinning have come in. The ring frame over the century had undergone a lot of changes eventhough the basic concept of drafting and spinning over a ring and traveller remains same.

The conventional old ring frame contains simple drafting rollers with dead weight for drafting followed by simple rings doing the job. The continuous design developments, right from the creel up to the design of the bobbin, have totally transformed the ring frame from a machine working at 5,000 to 6,000 rpm to a frame working at 18,000 to 20,000 rpm easily.

The revolving bobbin holders for the smooth unwinding of bobbins, the top arm pendulum drafting for better controlled drafting, the redesigned lappets for proper guiding of the yarn, the changed spinning geometry for imparting least tension of the yarn on high speeds, the redesigning of spindles, bolsters with bearing inserts to take up high speeds, the departure from conventional rings to new type of anti-wedge and low-crown rings, development in the ring traveller technology for consistency, better driving methods of the spindle with synthetic driving tapes, tangential belt driving systems, better cop build controls and more mechanical automation at the head-stock, better suction devices etc. in all have totally helped the ring frame today to achieve the present targets of running at 18,000 rpm and more and still producing much better quality yarn compared to the ones produced decades ago.

The over-head cleaning systems and better humidification systems have helped in eliminating the floating dust and fly in the department, thus helping to build a yarn of consistent quality free from faults. The auto doffer systems have further helped in increasing the productivity and quality. The ring data system ensures the continuous monitoring of the ring frame and today the spinner knows what is going wrong where. The testing instruments of new generation also helps the spinner to consistently and continuously monitor the quality and this also helps the spinners to identify the location of the faults and suggest corrections.

4.2 Auto-Coners

The final yarn needs to be delivered in the right package and the role of auto coners have a lot to say in this regard. With the development of good automatic cone winding machines, the spinners and also the machinery designers were forced to look in for developing the machines to produce a fault free yarn which could satisfactorily run in today's modern automatic cone winders. The modern auto coners continuously inspects the yarn and removes the faults and the better automatic piecing systems help in building a cone with a good fault free yarn. The electronics have major role to play in today's auto coners in ensuring this.

4.3 On Line Monitoring

II' the individual machine design has undergone tremendous improvements over the years, as explained above, today, the high degree of quality achievement is possible only with the excellent quality monitoring systems practically possible.

With the exorbitant use of electronics right through the process and on machines, it is possible to control the machine and the process individually or also in total. The machines have their own automatic controls and provide adequate data to the spinner for monitoring the process both in short terms as well as long term. The computer technology has helped in bringing the process data right on the spinners table thus helping the technicians to effectively improve efficiency and productivity as well as quality.

With the compatibility of control system of one machine to other, it is today possible to monitor the process on line. While random tests are no longer sufficient for effective quality management, on line monitoring systems are by far superior and ensures avoiding even accidental deviations.
The main features are:

- Permanent and complete monitoring
- Fast alarm in case of deviation
- Automatic production stops on the basis of preset limits
- Establishing data with long term analysis - Use as optimization tool
- Savings on laboratory testing

Different manufacturers have different systems on their own. However the requirements of the manufacturers are to achieve the monitoring of process in the following areas:

- Monitoring of sliver/yarn counts
- Monitoring of sliver/yarn evenness
- Establishing and analyzing spectrograms
- Visualization of machinery conditions
- I establishing data on short long term variations
- Log book function and reporting system
- Utilization and efficiency analysis
- Maintenance analysis.

Today, it is easy for the spinner to communicate with his machine and tune the machine to his requirement sitting in his chair. With this kind of control, it is possible to achieve high degree of quality at different levels if the other factors of productions are also effectively controlled.

V. SUMMARY

Quality management in yarn production is subject to continuous change. The expectations of the spinners and also users are constantly spiraling which continuously put huge demand on the machine designers for achieving the task. The machine development like another field is unending and whatever we feel superior today may not be able to satisfy tomorrow's needs.so, fault free yarn production demands state of art spinning machines with sound technical features for better processing of all types of Textile fibers.

VI. CONCLUSION

Aerodynamic cleaning, opening cotton to micro tuft size, auxiliary equipment's like metal detector, fire diverter and electronic controls improved Lapcv% in modern blow rooms.

Adjustable deflector blade in licker in offers variable cleaning at card. Aluminum steel bars, increased cylinder speeds, servo motor controlled doffer speed ensure high carding efficiency.

Auto-leveler controlled draw frame, pendulum arm drafting in speed frame and changed spinning geometry in ring frame have all contributed to the production of fault free yarn.

REFERENCES

[1] R.Chattopadyay,Editor - Advance in Technology of yarn production, NCUTE Publication 2002
[2] R.S.Rangasamy,Mechanics of spinning machinery - NCUTE Publication 2002.
[3] K.S. Taggard Cotton Spinning,
[4] Frank Charley,Manual of cotton spinning - Series Textile institute Butter Works -1964
[5] Productivity in Spinning , SITRA -1998
[6] T.R.Ratnana , KV. Sashay Quality Control in Spinning - SITRA-1994
[7] L. Ashok Kumar &Senthil Kumar- Automation in Textile machinery