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Analysis on the Defects in Yarn Manufacturing Process & its Prevention in Textile Industry

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ABSTRACT: *This paper is related to textile industry especially to Yarn manufacturing process. Textile is one of the biggest manufacturing industries in India.Defects rate of product plays a very important role for the improvement of yield and financial conditions of any company. Actually defects rate causes a direct effect on the profit margin of the product and decrease the quality cost during the manufacturing of product. Companies strive to decrease the defects rate of the product during the manufacturing process as much as possible. By checking and inspection of defects of product at different point in a production cycle and management implement some changes specifically at those points in production where more defects are likely to happen.*

The paper of defects rate of textile product in the yarn manufacturing process is so important in industry point of view. This process has large departments where the cotton passes in different process and may be effects the quality of yarn when it reaches the package form. A thousand defects opportunities create in the final package of yarn. In winding department where the final package of yarn is make. Final package of yarn is the end product and from it is direct send to the customers and if any final product passes with some defects and may chance the customer complaint.

The main thing of this paper is to give the understanding of different problems in different departments in quality point of view and how to reduce the problems by taking preventive action against any defects produce during process. Now days, defects rate reduction is so important especially in recession days, when every company wants to improve the financial goals and reduce quality cost of product.

Keywords: *Defects, Preventions, Yarn Manufacturing Departments, Textile Industry*

I. INTRODUCTION

This paper is related to textile industry especially to Yarn manufacturing process. In this paper identifies the different problems occurring during manufacturing of yarn in different processes, it also highlights the critical success factors which are most important in quality point of view. It also describes the preventive action against any failure.

In order to tackle the complex problems, the first thing is to construct a well-structured problem formulation "a good representation".

There are different types of problem formulation like

"What" what kind of problem that occurs during the yarn manufacturing process and its effects on quality

"Why" why the problems create during process

"How" how to solve the problems from different actions and implementation some rules in the process

In this paper describes different problems in quality perspective in different departments and identifies the reason for these problems due to carelessness of employees during manufacturing. Training of employees and preventive action against any failures in the department is necessary for any organization.[1, 2]

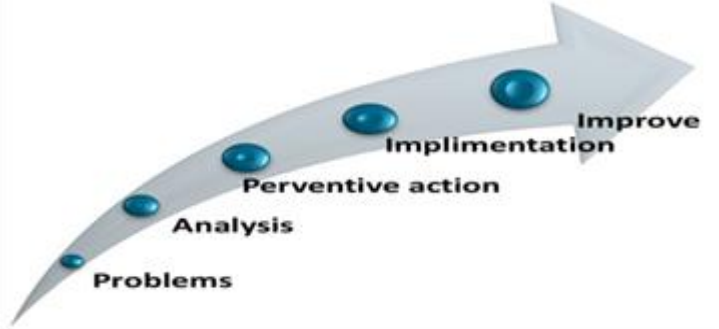

Fig. 1 Diagram of group member's idea

Yarn consists of several strands of material twisted together. Each strand is, in turn, made of fibers, all shorter than the piece of yarn that they form. [3] These short fibers are spun into longer filaments to make the

yarn. Long continuous strands may only require additional twisting to make them into yarns. Sometimes they are put through an additional process called texturing.

The characteristics of spun yarn depend, in part, on the amount of twist given to the fibers during spinning. A fairly high degree of twist produces strong yarn; a low twist produces softer, more lustrous yarn; and a very tight twist produces crepe yarn. [5] Yarns are also classified by their number of parts. A single yarn is made from a group of filament or staple fibers twisted together. Ply yarns are made by twisting two or more single yarns. Cord yarns are made by twisting together two or more ply yarns.

Almost eight billion pounds (3.6 billion kg) of spun yarn was produced in the United States during 1995, with 40% being produced in North Carolina alone. Over 50% of spun yarn is made from cotton. Textured, crimped, or bulked yarn comprised one half of the total spun.[6, 7] Textured yarn has higher volume due to physical, chemical, or heat treatments. Crimped yarn is made of thermoplastic fibers of deformed shape. Bulked yarn is formed from fibers that are inherently bulky and cannot be closely packed.

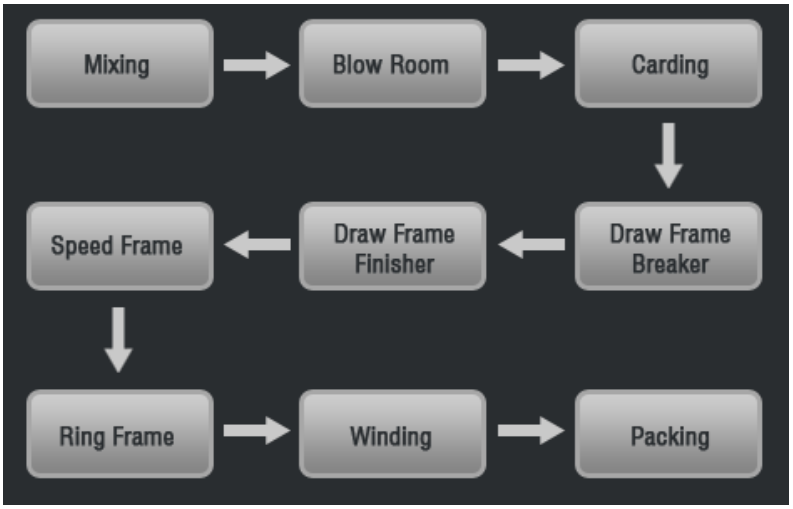

Fig. 2 Diagram of yarn manufacturing process

Yarn is used to make textiles using a variety of processes, including weaving, knitting, and felting. Nearly four billion pounds (1.8 billion kg) of weaving yarn, three billion pounds (1.4 kg) of machine knitting yarn, and one billion pounds (450 million kg) of carpet and rug yarn was produced in the United States during in 1995. [7,9,10] The U.S. textile industry employs over 600,000 workers and consumes around 16 billion pounds (7 billion kg) of mill fiber per year, with industry profits estimated at $2.1 billion in 1996. Exports represent more than 11% of industry sales, approaching $7 billion. The apparel industry employs another one million workers. [23]

II. HISTORY

Natural fibers—cotton, flax, silk, and wool—represent the major fibers available to ancient civilizations. The earliest known samples of yarn and fabric of any kind were found near Robenhausen, Switzerland, where bundles of flax fibers and yarns and fragments of plain-weave linen fabric, were estimated to be about 7,000 years old.

Cotton has also been cultivated and used to make fabrics for at least 7,000 years. It may have existed in Egypt as early as 12,000 B.C. Fragments of cotton fabrics have been found by archeologists in Mexico (from 3500 B.C.)., in India (3000 B.C.), in Peru (2500 B.C.), and in the southwestern United States (500 B.C.). Cotton did not achieve commercial importance in Europe until after the colonization of the New World. Silk culture remained a specialty of the Chinese from its beginnings (2600 B.C.) until the sixth century, when silkworms were first raised in the Byzantine Empire.[23, 24]

Synthetic fibers did not appear until much later. The first synthetic, rayon, made from cotton or wood fibers, was developed in 1891, but not commercially produced until 1911. Almost a half a century later, nylon was invented, followed by the various forms of polyester. Synthetic fibers reduced the world demand for natural fibers and expanded applications.

Until about 1300, yarn was spun on the spindle and whorl. A spindle is a rounded stick with tapered ends to which the fibers are attached and twisted; a whorl is a weight attached to the spindle that acts as a flywheel to keep the spindle rotating. The fibers were pulled by hand from a bundle of carded fibers tied to a stick called a distaff. In hand carding, fibers are placed between two boards covered with leather, through which protrude fine wire hooks that catch the fibers as one board is pulled gently across the other. [26]

The spindle, which hangs from the fibers, twists the fibers as it rotates downward, and spins a length of yarn as it pulls away from the fiber bundle. [23]When the spindle reaches the floor, the spinner winds the yarn around the spindle to secure it and then starts the process again. This is continued until all of the fiber is spun or until the spindle is full.

A major improvement was the spinning wheel, invented in India between 500 and 1000 A.D. and first used in Europe during the middle Ages. A horizontally mounted spindle is connected to a large, hand-driven wheel by a circular band. The distaff is mounted at one end of the spinning wheel and the fiber is fed by hand to the spindle, which turns as the wheel turns. A component called the flyer twists the thread just before it is wound on a bobbin. The spindle and bobbin are attached to the wheel by separate parts, so that the bobbin turns more slowly than does the spindle. Thus, thread can be twisted and wound at the same time. About 150 years later, the Saxon wheel was introduced. Operated by a foot pedal, the Saxon wheel allowed both hands the freedom to work the fibers. [27, 30]

A number of developments during the eighteenth century further mechanized the spinning process. In 1733, the flying shuttle was invented by John Kay, followed by Hargreaves' spinning jenny in 1766. The jenny featured a series of spindles set in a row, enabling one operator to produce large quantities of yarn. Several years later Richard Arkwright patented the spinning frame, a machine that used a series of rotating rollers to draw out the fibers. A decade later Samule Cromptons' mule machine was invented, which could spin any type of yarn in one continuous operation. [32]

The ring frame was invented in 1828 by the American John Thorp and is still widely used today. This system involves hundreds of spindles mounted vertically inside a metal ring. Many natural fibers are now spun by the open-end system, where the fibers are drawn by air into a rapidly rotating cup and pulled out on the other side as a finished yarn. [33]

III. BRIEF INTRODUCTION OF YARN MANUFACTURING DEPARTMENT

In under the yarn manufacturing department, there are mainly seven departments:

3.1 Blow Room Process

Blow room is the initial stage in spinning process. The name blow room is given because of the “air flow” And all process is done in blow room because of air flow. Blow room is consisting of different machines to carry out the objectives of blow room. In blow room the tuft size of cotton becomes smaller and smaller. Mixing of cotton is done separately as well as in blow room. Compressed layer of bale is also open in blow room with the help of machine**.** [34]

Fig. 3 Diagram of Blow Room Department

3.2 Carding Process

Carding process is very important role in spinning mill. It helps us both way to open the tuft into a single fiber and to remove the impurities and neps. Textile experts are convinced for the accuracy of following statement.

“The card is the heart of spinning mill” and “well carded is well spun”

Card feeding is done by two ways. One is manually and other is through chute feed system. In manual case the lap which is produced in blow room and it is feed to the card. In chute feed the material is feed through air flow system to card machine. [35]

It is important to say that lower the feed variation better is the carding quality. Lower the feed variation then draft variation will also be less. Then yarn quality will be consistent. If the card is having auto leveler then

nominal draft should be selected properly. In some circumstances card also act as a cleaner and remove a certain amount of short fiber. Approximately 90% cleaning efficiency is achieved with the help of carding machine.

Fig. 4 Diagram of Carding Department

3.3 Drawing Frame Process

Draw frame is simple and cheap machine. In spinning regarding to quality point of view it play very important role .If its setting is not done properly then it affects yarn strength and elongation. For improving quality draw frame is final process in the spinning mill. It effects on quality especially on evenness of sliver. In the spinning process there are chances of elimination of errors in draw frame machine. Draw frame play very important role for the quality of yarn. Without it participation quality can never be improved. Drafting arrangement is the heart of the draw frame. Drafting arrangement should be simple, stable design, should have ability to produce high quality product. It should have high fiber control. Auto leveler is also used to adjust and to improve the linear density of the sliver. Without auto leveler it is very difficult to improve the quality of the draw frame sliver. [36]

Fig. 5 Diagram of Drawing frame Department

3.4 Combing Process

For getting high quality of yarn, one extra process is introduced which is called combing process. Combing is an operation in which dirt and short fibers are removed from sliver lap by following ways.

- In specially designed jaws, a narrow lap of fiber is firmly gripped across its width
- Closely spaced needles are passed through the fiber projecting from jaws.

Short fiber which we remove is called comber noil. The comber noil can be recycled in the production of carded yarn. Yarn which is get from comber sliver is called comber yarn. Carded sliver are combine into comber lap in a single continuous process stage. Flat sheet of fiber which is get from comber lap is fed into the comber in an intermediate. [37, 38]

There are different ways by which value of combing is used in the manufacturing of cotton. By spinning point of view combing process makes more uniformity in the yarn. Strength of yarn is also high because in combing process short fiber are removed and only fiber having good strength remains. So it play very important role for increasing the yarn strength. Because of straightened condition of fibers combing makes

possible spinning smoother and more lustrous yarn. In combing process length of fiber are strong so it need less twist produced then carded yarn.

Fig. 6 Diagram of Combing Department

3.5 Roving Frame

It is an intermediate process in which fibers are converted into low twist lea called roving. The sliver which is taken from draw frame is thicker so it is not suitable for manufacturing of yarn.

Its purpose is to prepare input package for next process. This package is to prepare on a small compact package called bobbins. Roving machine is complicated, liable to fault, causes defect adds to the production costs and deliver the product. In this winding operation that makes us roving frame complex. There are two main basic reasons for using roving frame. [44]

- The roving sliver is thick and untwisted. Because of it hairiness and fly is created. So draft is needed to reduce the linear density of sliver. The ring drafting arrangement is not capable that it may process the roving sliver to make the yarn.
- Draw frame can represent the worst conceivable mode of transport and presentation of feed material to the ring spinning frame. [40]

Fig. 7 Diagram of Roving Frame Department

3.6 Ring Spinning Process

Ring Spinning machine is used in textile industry to twist the staple fibers into a yarn and wind on a bobbin for storage and also input for the winding section for more precise the yarn to minimize the defects of end yarn. Ring machine is very important due to yarn quality.

Ring Spinning is the most costly step to convert fibers into yarn and approximately 85% yarn produced in ring spinning frame all over the world. It is made to draft the roving into a desired count and impart the desired twist to produce the strength in the yarn. If twist is increased, yarn strength is also increased at optimum limit. [45]

Fig. 8 Diagram of Ring spinning Department

3.7 Winding Section

It is the last section of yarn manufacturing process where auto cone machines are installed and take an input material from ring spinning section as a yarn bobbin and give a yarn on paper cone after passing detecting instrument as an output. In winding section, there are lot of heads in auto cone machines use to wound the yarn from ring bobbin yarn to paper cone yarn. Now days, there are some companies to manufacturing these machines and Savio company is one of them which produce a fully automatic machine for spinning industries. In quality point of view, it is a very good machine and has also very low maintenance cost.

Winding department plays an important role in the production and quality of yarn and causes direct effect on them. The yarn which made in ring section is not finish yarn and can't sell to customer. After making the yarn in ring process, auto cone section made it more even yarn by passing through the optical sensor which is installed in different heads of machine. The yarn which is obtained from winding section is able to sell the customers. [46]

Fig. 9 Diagram of Winding Department

IV. DEFECTS IN YARN MANUFACTURING PROCESS & ITS PREVENTION

4.1 Blow Room

Blow room is the initial step for yarn manufacturing process in spinning mill. In blow room cotton bales are opened and cotton is transfer from different number of machines with the help of air flow. This chapter clears the main objectives of blow room such as opening, cleaning and mixing and also describes the technical point regarding to quality point of view. Here also describes the defects which affect the yarn quality and preventive action to cover these defects according to quality standard. There is lot of things in this department which is described below:

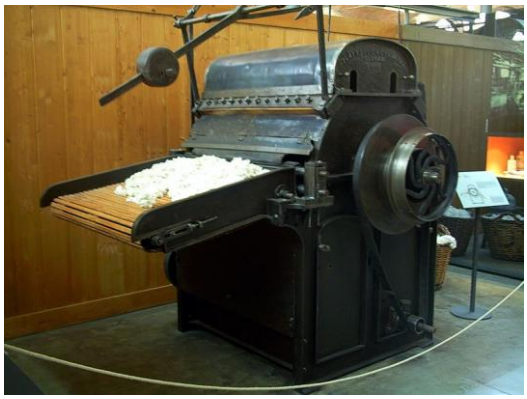

Fig. 10 Diagram of blowroom

4.1.1 Objective of Blow Room

Following are the basic operation or objectives of blow room:

- Opening
- Cleaning
- Mixing or blending
- Micro dust removal
- To extract the contamination in the cotton such as leaf, stone, iron particles, jute, poly propylene, colour fibers, feather and other foreign material from cotton by opening and beating.

- To uniform feeding to the next stage such as carding machine.
- Recycling the waste material.

4.1.2 Technical points in Blow room

Following are the technical points in the blow room:

- Opening in blow room means opening the cotton in small pieces. The operation of opening means to increase volume of flocks while the number of fiber in the flock remains constant. That is the specific density of material is reduced.
- If the size of dirt particle is larger, it can be removed easily.
- A lot of impurities and contamination are eliminated at the start of the process.
- As much opening of cotton will be more, cleaning result will be more acceptable. But this cleaning of cotton is done on the basis of high fiber loss. High roller speed gives more better cleaning effect but also more stress on fiber. So roller speed is adjusted at a nominal speed so there should be well opening of cotton and it does not effect of quality of fiber.
- Cleaning efficiency of cotton is depending upon trash percentage. The cleaning efficiency is different for different verities of cotton with same trash percentage.
- If the opening of cotton is done well in initial stage then cleaning becomes easier. As surface area of opened cotton is more, so therefore cleaning is more efficient.
- In traditional method more number of machine are used to open and clean natural fiber.
- If automatic bale opener machine is used, the tuft size of material should be as small as possible. In this way more efficiency of machine is achieved and machine stopping time is reduced.
- For the opening of cotton, use inclined spiked lattice (tray) at the initial stage always a better way of opening of cotton with minimum damage.
- Mechanical action on fibers creates some problems in the quality of yarn in the form of neps.
- In beating operation by using a much shorter machine sequence, fibers with better elastic properties. In this way spin ability can be produced.
- Stickiness in the cotton affects the process very badly in the way of production and quality.
- It is necessary to control the temperature inside the department, when use stickiness cotton.
- Released of dust particles into the air occurs whenever the raw material is rolled beaten or thrown about. Accordingly the air at such position is sucked away. For the removal of dust perforated drums, stationary drums are used.

4.1.3 Factors affecting on opening, cleaning and fiber loss

These are the general factors which affect the degree of opening and cleaning

- Type of opening device
- Speed of opening device
- Size of flocks in the feed
- Thickness of feed web
- Density of feed web
- Degree of penetration
- Fiber coherence
- Fiber alignment
- Distance between feed and opening device
- Through put speed of materials
- Type of grid bar. Grid bar is part of blow room machine which is used for cleaning and opening purpose.
- Air flow through the grid bar
- Condition of pre-opening
- Amount of material processed
- Ambient relative humidity percentage
- Ambient temperature

Atmospheric condition of blow room is also important to produce smooth and uniform quality yarn. It also affects the raw material that why it is very important to maintain ambient temperature and ambient relative humidity percentage in the blow room throughout the production. Low humidity and slightly higher temperature are preferred because of the cotton opening temperature. [42]

4.1.4 Critical success factors for Blow room

For achieving yarn quality following are the critical success factor

- Cleaning efficiency
- Fiber growth

4.1.5 Importance of yarn quality

For producing high quality yarn, it is necessary to follow quality standards according to the customer needs and Market requirement. High value quality yarn is produced, if high quality yarn with minimum deviation is used. If fluctuation in yarn quality is high then it will be difficult for end use.

4.1.6 Guideline for Achieving Yarn Quality

- For producing high quality yarn, there is need of high standard raw material. Hence 70 to 80 % of basic yarn quality is decided by raw material cotton. There is a direct relationship between certain quality characteristics of fiber and yarn.
- Short fiber content is very important for producing yarn quality; 4 to 5 mm of fiber length is lost during processing. Fiber having 12 to 15 mm don't contribute to strength but only the fibers more than this length contributes to produce positive characteristics in the yarn.
- Fiber length should be more than 28 mm. This fiber length effects on yarn strength and yarn uniformity. End breakage also depends upon fiber length. For better yarn quality fiber length should be more than 28 mm.
- Micronaire (fiber fineness) value should be 3.8 to 4.2. If micronaire is coarse, this always results in lower strength and lower elongation.
- Cotton having stickiness should not be used. If cotton is sticky then it is better to reduce the percentage of sticky cotton in mixing. For such kind of cotton there is need of low humidity and high temperature.
- Cotton with less contamination should be used.

Process requirement for Blow room by quality point of view:

- If micronaire value is low, then process parameter of blow room becomes very critical.
- After blow room process the neps increase in cotton.
- In case of increasing the neps, the beater speed should be reduced instead of feed roller to beater setting.
- Fiber rupture should be less than 2.5 percent.
- Blow room setting should be set in such a way that the draft in cards is same for all the cards and the variation in feed density is as low as possible.
- If trash percentage in cotton is less and number of neps in the sliver is more than at this stage, reduce the beating point. 3 beating points should be more than enough. [43]

4.1.7 Defects and Causes

- Neps formation
- Curly cotton due to tight gauge
- Lap clicking

4.1.7.1 Causes of neps formation in blow room

Due to following points neps formation takes place. And these nep formations strongly affect the yarn quality

- Because of too high or low moisture of cotton.
- Neps formation takes place when there is extremely fine cotton with high trash content.
- Reprocessing of laps and mixing of soft waste cotton, if the reprocessing, this will create bad effect of yarn quality. During reprocessing maximum neps are create which are difficult to remove in the next stage. So it is needed to avoid reprocessing of laps and soft waste cotton.

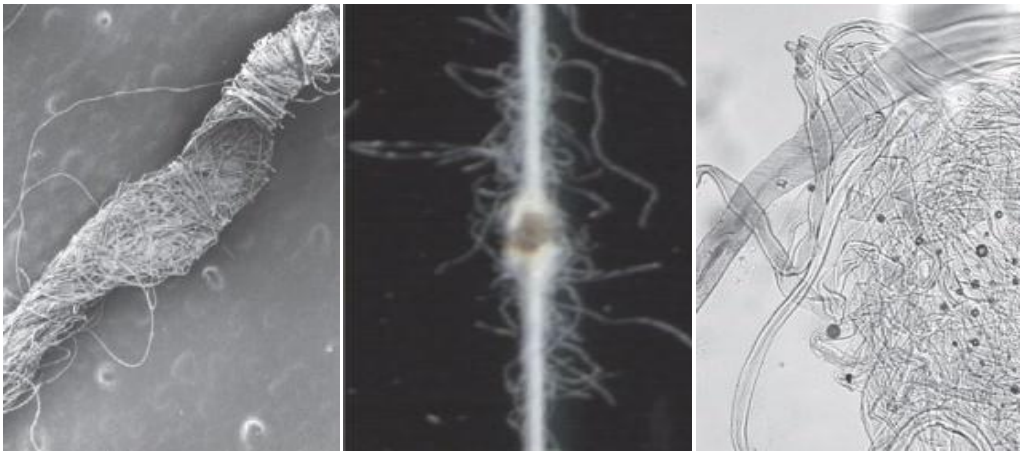

Fig. 11 A NEP Formations in Yarn

4.1.7.2 Causes of curly cotton

Due to following points of curly cotton it should be set the parts of machine in a proper way so that following causes does not happen

- Grid bar is the part of blow room machine which is used for cleaning purpose. Grid bar settings are very close to the beater.
- Causes of curly cotton are due to hooked or bent pins in beaters.

4.1.7.3 Causes of Lap Licking

Due to the following points lap clicking occurs. Lap is the output of blow room which is used for next step such as carding machine. To avoid the lap of licking we use roving ends within the lap to act as a layer separation.

- Soft waste cotton should not use in mixing because it will create problem in the next stage.
- Sticky nature of cotton, so avoid sticky cotton.

4.1.8 Preventive Action

4.1.8.1 Preventive Action for Neps Formation

- For avoiding neps formation it is necessary to select the cotton according to moisture content in the cotton. In both cases if moisture content is less or more, our process will become critical.
- As quality of our end product depends upon raw material. If cotton having more trash content then it is necessary to increase beating point. And this beating will directly affect our neps formation and neps formation will be more.
- Cotton mixing supervisor should take action that during mixing soft waste and process lap not to be mix with fresh mixing. This step is necessary to avoid neps formation. As neps formation affect the quality of our yarn.

4.1.8.2 Preventive action for curly cotton

- For getting good quality product it is necessary to keep trained staff for maintenance point of view. There is a need of technical person who have full grip on their work. They should check the setting of machine and to keep machine update to avoid the problems. Machine setting must not be wide not so close to avoid curly cotton problem. [40]

4.1.8.3 Preventive action for lap licking

- In order to prevent from lap licking it is necessary not to mix soft waste during mixing process.
- Avoid sticky nature cotton as in case sticky nature cotton then as a preventive action inside temperature of department is to be controlled. In this case low relative humidity and high temperature is needed.

4.2 Carding Section

The second step in the yarn manufacturing process is the carding. The blow room transfers the open cotton to this section through a pipe line for further process. Carding is the heart of spinning mill and in this section maximum cleaning of cotton is done. In this stage the cotton is more opened and separates the fiber individually. In this section the material is collecting in a can in the form of rope (the technical word is silver). This section also describes the technical point, critical success factor, preventive action and also describes the defects rate which affects the yarn quality.

Fig.12. Diagram of Carding section

4.2.1 Objective of Carding Section

- To open the flocks and separate the fiber individually.
- Cleaning or elimination of impurities.
- Reduction of neps formation.
- To change the fiber into longitudinal direction or fiber alignment.
- Fiber blending.
- Removal of short fiber.
- Formation of sliver.

4.2.2 Technical points in Carding Section

Feeding of material to the card is done in a two ways:

- Feed the material in the form of lap.
- Feed the material in the form of flock feed system.
- Flocks are transported with the help of air flow.

4.2.3 Feed the material in the form of lap

- Lap is the thick form of cotton sheet which is feed to the carding machine. The Linear density of the lap is very good and it is easier to maintain uniformity.
- Lap takes heavier load in taker-in as laps are heavily compressed.
- After the run out of lap feeding, when new lap is feed during this there is good fiber loss.
- In lap feeding auto- leveler are not required, hence investment and maintenance cost is less.[46]

4.2.4 Flock feeding

- High production is achieved by flock feeding system.
- In flock feeding auto-leveler is used which maintain the uniformity of sheet automatically. So investment cost and maintenance cost is more.
- In flock feeding high performance is achieved in carding due to high degree of openness of feeding cotton sheet.

4.2.5 Importance Points for Quality of Yarn

Importance of quality in carding department depends upon following points:

- If wires are selected properly then 70% quality will be achieve in carding section.
- Cylinder speed depends upon micronaire value. If micronaire value is lower than 3.5 the cylinder speed should be around 350 rpm. If micronaire is between 3.5 to 4 it can be around 450 rpm. And if micronaire is more than 4 than it can be around 500 revolution per minute.
- Grinding of the flat tops should be done once in a three month for better yarn quality. Flat tops play a major role in reducing the neps.
- Licker-in and stationary flats wire should be changed after specific life mention by the company for achieving good yarn quality result.
- Auto leveler setting in the card should be proper. Nominal draft should be correct.
- Stopping time of the carding machine should be as minimum as possible.
- In the carding machine 10 meter C.V % of card sliver should be less than 2.
- Sliver weight difference between cards should not be more than 2.5 %.

- Trash in sliver should be less than 0.1%.
- Uniformity ratio of sliver should be same or better than raw material cotton
- If the quality from a particular card is bad, immediate action to be taken to remove the problem. Lower the variation improves the yarn quality.[48]

4.2.6 Critical Success Factors

In carding section, critical success factors play a very important role to enhance the quality of yarn such as cleaning of material, %age of neps removal, grains (wt.) per yard and also CV of output material.

4.2.7 Defects in Carding and Causes

- Causes of high sliver variation.
- Nep formation
- Holes or patches in card web
- High sliver variation in due to difference in draft between card
- Worn clothing and feed roller bearing also create variation in card sliver.
- If auto leveler is not working properly than this will also create high sliver variation.
- If auto leveler is off then check the wrapping of carding after every 30 minutes.

4.2.7.1 Causes for Neps Formation

- Insufficient stripping
- Dirty under casing (grid bar)
- Uneven flats setting
- Under casing chocked with fly (waste)
- High roller speed

4.2.7.2 Causes for Holes or Patches in Card web

- Poor flat stripping
- Hooked or damaged wires on flats
- Damaged cylinder
- Cluster of cotton embedded on cylinder wires

4.2.8 Preventive Action

- In order to avoid sliver variation draft calculation should be correct. Testing of sliver must be on time at least 3 times during shift.
- High sliver variation problem may also be due to maintenance problem. So concentrate on maintenance. If our maintenance of machine will be there, then it will get more efficiency and better quality will be achieved. If expiry time of some part of the machine is there, then on time it must be replaced.
- Now a days in advance technology the cards, auto leveler are electronic which adjust the sliver weight automatically. For getting better result with automatic auto leveler, it is also necessary to check sliver weight manually as well.[45]

4.2.8.1 Preventive action for NEP formation

- Over hauling of machine must be on time. During over hauling, setting of every part of the machine has to be checked. Flat setting play very important role for reducing nep formation. So flat setting must not be uneven.
- Suction waste point should be properly working. This point must not be chocked. If there will be chock then neps formation will take place. Suction waste point also to be checked manually as well.
- This problem is also related to maintenance. Over hauling of every machine must be on time. Wire of flats and cylinder have specific time limit of production. After that specific time limit it must be changed. As these play very important role by quality point of view.

4.3 Draw Frame Section

After carding process the material is transfer to this section in the form of rope (the technical word is silver). The carding rope (silver) is in curly form so for further process to remove this curly form, draw frame machine is used. In this section the sliver get more parallel and uniform. This chapter also describes the technical point. Critical success factor, preventive action and also describes the defects rate which affect the yarn quality.

Fig. 13 Diagram of Draw frame section

5.3.1 Objective of Draw Frame

- Parallelization of material.
- To improve evenness by doubling many card sliver.
- To produce uniformity in the material by mixing and blending different card sliver.
- Elimination of short fiber and fine dust by suction.
- To achieve sliver fineness by auto leveller
- Drafting.

5.3.2 Technical points in draw frame regarding to setting

- If back roller setting is wider then it disturbs the yarn strength. It also affects yarn evenness and increases imperfection (neps 200%, thick +50, thin -50).
- If pressure increases in back top roller then yarn strength is decreased and breakage rate is reduced.
- If front roller speed is to be keep more wider then it improve the yarn strength.
- Sliver uniformity can be reduced if draft is more but fiber parallelization is improved.[48]

5.3.3 Critical success factor

- Auto leveller gauge setting.
- C.V% of output sliver.
- Grains per yard.

5.3.4 Factor which affect the yarn quality

Following are the factors which affects the yarn quality:

- Fiber length
- Types of drafting
- Delivery speed
- Fiber fineness
- Auto leveler setting
- Break draft
- Total draft

5.3.5 How Much Importance for Quality?

Following points are very important regarding to quality in draw frame:

- For improving quality auto leveller is very necessary. Auto levellers fulfil the requirement according to need.
- Draw frame sliver test is very necessary after every ten days. A% (alarm of bad quality) should be less than 0.8%.
- 1 meter C.V from uster testing machine should be less than 0.6.
- For improvement in quality, top roller buffing (polishing) should be done within a month.
- After every hour there should be cleaning of top roller. If cleaning will not be there then sliver variation will be more.
- 10 meter sliver should be wasted when start the machine after overlapping, because if it is used in process then C.V may be increased.

- Machine setting should be proper otherwise that back creel sliver breakage will increase. In this condition sliver piecing will be more.
- From quality point of view 10 meter sliver should be wasted.[49]

5.3.6 Causes of draw frame sliver variation

These are the following point which affects the variation in draw frame

- Break draft.
- Improper handling of material.
- Over filling of can with material.
- Top roller overlapping.
- Thick piecing of sliver when sliver is break.
- Improper working of auto leveller.

5.3.7 Preventive action of Frame sliver variation

- To avoid sliver variation it should be concentrated on break draft. For cotton processing break draft is normally from 1.16 to 1.2 because if improper break draft is given, it will affect the quality of yarn in the form of thick and thin places.
- Production department supervisor should cover draw frame material with polythene sheet to avoid fine dust otherwise it will create variation in the sliver. Fresh material is to be given to the next process, if fresh material not use then it will create variation in the sliver.
- Draw frame material is very sensitive and it must not over fill. In case it compresses the material in the can, and it raptures the surface of sliver. So production supervisor should be strictly avoiding this.
- Top roller cleaning is to be done after every 1 hour. In this way variation will be decreased in the sliver.

5.4 Combing section

Combing section is used for get high quality in yarn manufacturing process. In this section the cotton is comes in the form of lap which is produce in lap former machine. In this section short fiber are removed from the cotton sheet and only that fiber which have a long length are used for getting high quality yarn. The output of combing is also in the form of sliver which is more parallel and smooth. In this section, describes of objectives, technical point, critical success factors, preventive action and defects of section which affects the quality of yarn.

Fig.14 Diagram of combing section

5.4.1 Objective of Combing Section

The main objectives of the comber process are given below:

- Elimination or removal of short fiber.
- Removal of impurities and fine dust from the cotton.
- To make the fiber more parallel and straightens.

5.4.2 Importance of combing process by quality point of view

Combing process is use for upgrading of the raw material. It influences the quality of yarn. Quality of yarn is affected by following main reasons:

- Yarn evenness
- Smoothness
- Cleanness
- Strength
- Visual appearance

The point which is discussed above is used for improving the strength of the yarn. Less twist is needed in this case because short fiber is removed here and fiber only having long length remains.

These are following points which are very important for quality point of view:

- As much lap weight will be more then quality according to that will be lower. It depends upon comber type and fiber fineness.
- If micronaire will be fine, lap weight can be reduced to improve combing efficiency. If micronaire will be coarse then lap weight will be increase.
- If draft will be less than fiber penalization will be less and there will be more chances of loss of fiber.
- Top comb condition should be good. If damage top comb will be used then it will badly effect of yarn quality. Top comb is very important by quality point of view.
- If cotton with low maturity is used then removal of short fiber is very necessary to avoid dying problem.

5.4.3 Critical success factors

Following are critical success factors for combing process which affect the yarn quality:

- Noil percentage (short fiber %age)
- Top comb penetration
- The number of needle in top corn
- Total draft between carding and combing action
- Short fiber content in material
- Fiber fineness

5.4.4 Defects and causes in combing

- Lap wt. variation
- Number of piecing in comber
- Brush cleaning problem

5.4.5 Preventive action

5.4.5.1 Preventive action for lap licking

This fault is due to raw material properties such as micronaire, if micronaire value is less than 3.8 then lap lacking tendency will be more. Preventive action for such problem, it is necessary to concentrate on total draft between card and comber. This draft should be as low as possible that should be around 8.5.

5.4.5.2 Preventive action for Number of piecing in comber

Piecing is a periodic variation. The amplitude of this fault should be as low as possible. Following affects this fault:

- Detaching roller timing.
- Arranging this fault before entering to draft zone as this fault cancel each other. Now we will discuss about preventive action according to number of piecing in comber. As number of piecing in comber will be less then it will give us good quality of yarn.
- It is necessary for supervisor that he strictly guides to the worker that how much piecing is important regarding to improvement of quality.

5.5 Roving frame section

The input of roving frame is silver that comes from draw frame section where only parallel of comber sliver. In roving section reduce the linear density of draw frame silver by drafting. After reducing the linear density the silver is transfer into roving (a thin form of rope). This is first stage where twist is inserted for making a yarn in spinning mill. The output of this section is roving which is wind on a bobbin and this is suitable for further

process. Here in this section describes a clear view of roving section objectives and technical point, critical success factor, preventive action and defects in the section.[50]

Fig. 15 Diagram of Roving frame section

5.5.1 Objectives of Roving frame section

The main objectives of roving frame are given below:

- Drafting the draw frame sliver into roving.
- To insert the twist into the roving.
- Winding the twisting roving on bobbin.

5.5.2 Function of Roving Frame Section

5.5.2.1 Drafting

In roving frame two drafting frame are used.

- In 4 over 4 drafting system, total draft should be 13 and in 3 over 3 drafting system the total draft should not be more then 11.
- 3 over 3 drafting system is better in that case when there is good fiber length.

5.5.2.2 Twisting

It is very important factor which produces strength in the roving and twist is inserted with the help of flyer. When flyer rotates, the twist is produce in the sliver. Twist level depends upon flyer speed and delivery speed.

5.5.2.3 Winding

For winding purpose we used builder motion. Important task of winding are:

- Shift the cone belt corresponding to increase in the bobbin diameter.
- Reverse the direction of movement of bobbin rail at the upper and lower ends of the lift stroke.

Fig. 16 Diagram of winding process

5.5.3 How Much Important for Quality?

The following are the main point regarding to quality in Roving machine.

- From quality point of view the break draft should be around 1.18 to 1.24. But break draft depends upon the drafting system and total draft.
- Buffing should be on time and fter 20 days there should be buffing. If buffing is not done on time then it will create problem in the yarn such as thick and thin places.

- Spacer (distance strip) color also affects the quality of yarn. We should change the color according to roving count.
- Bottom and top apron also effect on quality in the form of thick and thin places produce.
- Density of roving bobbin should be same as in this case if variation will be there then count C.V will increases.

Fig. 17 Diagram of roving process

5.5.4 Critical Factors Affecting Roving Strength

Critical factors affecting roving strength are given below:

- The amount of twist and compactness of the roving.
- Linear density and uniformity of the twist.
- CV% of roving.

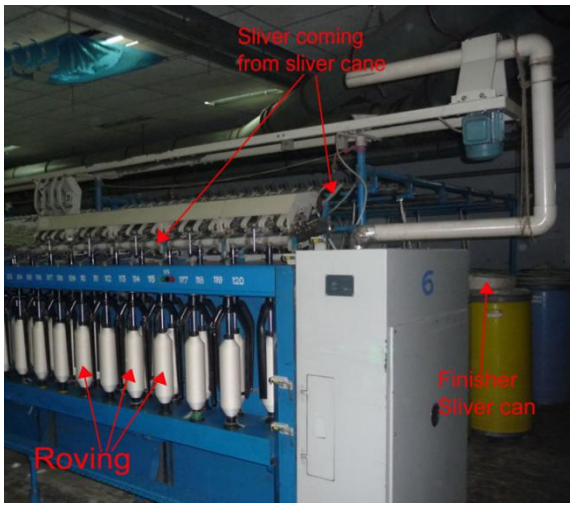

Fig. 18 Diagram of Roving Section

5.5.5 Defects and causes in roving

Following are the defects and causes in roving:

- Roving tension
- Improper handling of material
- Improper piecing in roving
- Roving breakage

5.5.6 Preventive action

5.5.6.1 Preventive action for roving tension

Roving tension is directly related to machine. The roving tension depends upon delivery rate and the difference between flyer speed and bobbin. For preventive action we should keep the delivery length and the speed difference constant then the tension in this case will be ideal.

5.5.6.2 Preventive action for improper handling of material

Roving material is very sensitive regarding to quality point of view. It is necessary to take care of material. The material should be handled in such a way that fine dust must not affect the material. It must be avoided touching

because of its sensitivity. Fresh material should be used for next process. This material should not be keep for long time. If it will be kept for long time then it will create variation. C.V% increases if material is not used.

- Supervisor must treat its worker in a proper way so that handling of material should be according to policy of mill.

5.5.6.3 Preventive action for improper piecing in roving

Supervisor should train his workers in a proper way. If end breakage is disturbed then its treatment should be proper. If piecing will not be proper then it will affect the next process.

5.5.6.4 Preventive action for roving breakage

This problem is caused due to maintenance problem. Maintenance required machine stoppage but it is against the production. To enhance the quality of product, the machine maintenance is the chief requirement. For the proper solution of roving breakage, speed of machine, trained operator and proper management should be must otherwise it create sever problems in ring section.

5.6 Ring Spinning Section

The input of ring frame is roving which comes from roving section this is final stage where yarn is make. Here in this section need more drafting to reduce the liner density of roving and more twist to make a yarn. The output of ring frame is yarn which is wound on a ring bobbin which is used for next winding process. Here also describes the clear view of ring frame objective, technical points, preventive action and defects which affect the yarn quality.

Fig. 19 Diagram of Ring spinning section

5.6.1 Function of Ring Process

There is a different function of Ring Spinning process in which roving is converted into yarn through passing different zone like drafting, twisting and winding zone. There are three important zone of Ring processes below here:

- Drafting Zone
- Twisting Zone
- Winding Zone

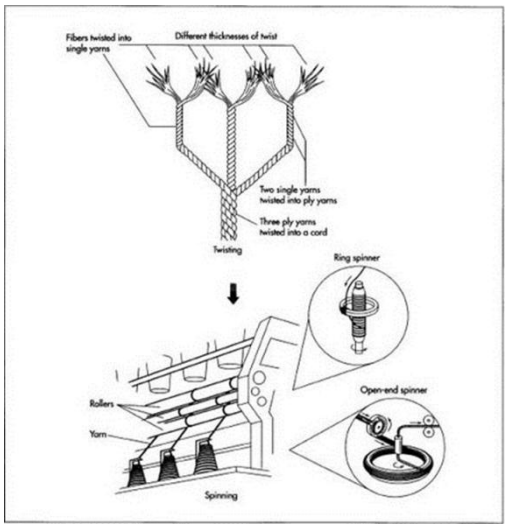

Fig. 20 Diagram of Ring spinning process

5.6.1.1 Drafting Zone

Drafting is the first zone of ring process and is very important part of machine and mostly effects on the evenness and strength of yarn. In quality point of view, there are many points which are related to the quality of drafting system.

- Type of the draft
- Selection of drafting parts like apron, rubber cots
- Range of draft
- Draft designing and setting
- Service and maintenance
- Type of perforated drum

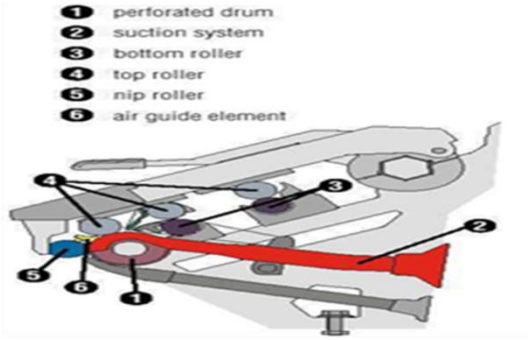

Fig.21 Diagram of Drafting System

5.6.1.2 Twisting Zone

It is the second zone and is also very important part of Ring machine in which the strands of fiber are converted into a yarn by the twist inserted. The strength of yarn is depend upon the amount of twist which are given in twisting zone and it is most important than other zone due to required strength of yarn.

There are some very important points related to twisting zone below here:

- Material and type of traveller
- Wear resistance
- Lubrication of fiber
- Smooth running
- Speed of traveler

These above points are very important in yarn quality point of view; otherwise these cause very negative effects and increase the defects in the yarn quality.

5.6.1.3 Winding Zone

This is the last section of ring machine in which yarn is wound on the plastic bobbin by the up and down movement of ring rail which is linked to a small motor. It is also very important because the setting of ring rail makes coils of yarn on bobbin in such a way that the Z-twist is not open during winding process.

Some points are very important during winding process:

- Ring rail speed setting
- Bobbin material
- No. of coils per inch[48]

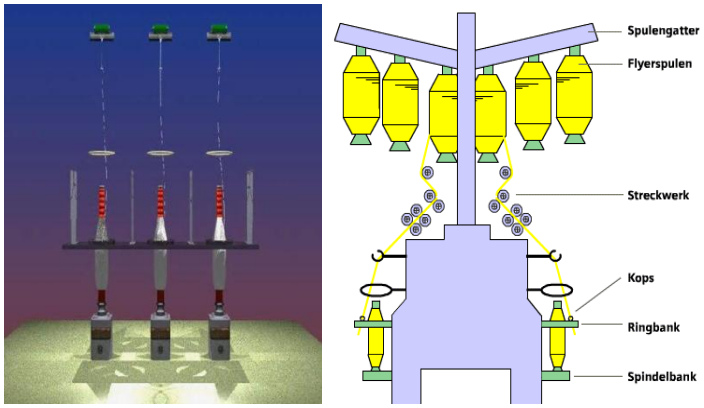

Fig.22 Diagram of Twisting System

5.6.2 Ring Spinning Effects on Quality

Ring spinning is the first stage of post spinning in which yarn produced from the roving installed on the hanger on the ring machine. Ring process is the heart of textile plant and there is lot of factors effect on the yarn quality.

- Speed of machine makes a major role on the yarn quality, as the speed increase of ring machine, the imperfection (Neps 200%, Thick +50, Thin -50) of yarn increase.
- Hairiness is also affected in ring production process and mainly produced by the movement of burnt traveler and high speed of machine.
- CV of count is also very important and ring spinning process is the last stage of process where we can reduce the CV of yarn count.
- Imperfection of yarn count in quality point of view is so important that every customer required this quality standard, that imperfection should be minimum as possible.
- Ring spinning process also effects on twist variation during manufacturing of yarn. It causes major problems during working in next process.[51]

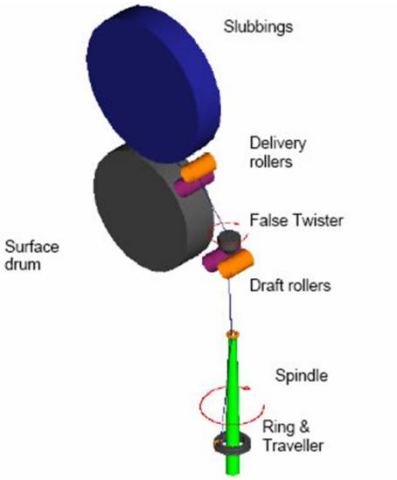

Fig. 23 Diagram of Ring spinning frame

5.6.3 Problems in Ring Process

Ring spinning process is a very critical process in the whole plant and it has also the direct relation to production of plant. It's difficult to manage it and lot of problems occurs during process. Following are some production, mechanical and electric problems here.

- Most of operators don't know about how to handle the machine.
- Due to lack of training of employees, they can create problems when they work in the department like problems of material handling, wrong traveler and bobbin colour.
- Ends down is the major problems in ring machine and it cause an efficiency and production loss.
- Due to lack of training of maintenance staff, mechanical fault is creating a problem and loss of mechanical parts, efficiency and production of plant.
- Improper maintenance is also creating problems related to maintenance and electric fault during running of machine.[52]
- Electric problems are also occurred due to lack of electric staff and they are unable to take corrective and preventive action against any fault.
- Some faults are occurred due to manufacturer of machine like software problem, communication problem and load capacity problems.

Fig. 24 Diagram of Ring Spinning Process

5.6.4 Critical Success Factors

In ring spinning process, there are some critical success factors which directly effect on yarn quality and profitability of the plant.

5.6.4.1 Strength of Yarn

If there is need to reduce the defects and improve quality of yarn, strength of yarn is so important that without it we can't take best results in the next process. Strength of yarn depends on twist of yarn, as the twist increases the strength is also increases up to a certain limit.

5.6.4.2 CV of Yarn

From customer's point of view, CV of count is very important and it's difficult to achieve and maintain in the ring spinning process. CV of yarn is the variation of different parameters like, strength, count etc.

5.7 Winding Process

The cop who is prepared in the ring frame is not suitable for further process. So the yarn is converted into the shape of cone which is prepared in the winding. Practical experience shows that winding process alters the yarn structure. The factors which affect the yarn structure during winding are bobbin geometry, bobbin unwinding behavior, binding speed. This phenomenon does not affect the evenness of the yarn but it affects the properties of the yarn such as thick places, thin places, neps, and hairiness.

Fig.25 Diagram of Winding Department

For better understanding of process, following are the main operations of winding section:

5.7.1 Objectives of winding

- Elimination of disturbing yarn fault such as long thick places, long thin places, short thin places and short thick places.
- To get the continuous length of yarn on cones for weaving process.
- To wax the yarn during the winding process.
- To get high efficiency of machine, that is high production level.

5.7.2 How Much Importance for Quality?

Following point should be considered for quality point of view:

- Winding speed should be 1200 meter per minute for getting good quality.
- For getting good quality, yarn fault clearers device setting should be as close as possible in order to eliminate the disturbing yarn faults.
- In order to get good quality of yarn count channel setting should be less than 7%.
- Cone which we prepare for weaving purpose should have minimum fault for getting good quality, especially long thin places and long thick places.
- For getting good quality yarn, splice strength must be 75% more than of the yarn strength.
- Splice appearance should be good. Splice device should be checked twice in a week.
- To get better efficiency cone weight should be 1.8 to 2.4
- Yarn winding tension must not be high during winding. If we will keep it high then tensile properties will be affected such as elongation and tenacity.
- If waxing attachment is below the clearers, the clearers should be clean at least once in a day.
- Wax roller should rotate properly.[53]

5.7.3 Yarn faults and clearing

It is not possible that the yarn which produces is without faults because of different reasons. Stickiness of cotton can contribute to the formation of thick and thin places. Fly in the ring department is also one of the main reasons for short faults in the yarn. Because of the fly get spun into the yarn. Hence it is not possible to have fault free yarn from ring spinning. So it is necessary to have yarn monitoring system in the last production process in the spinning mill.

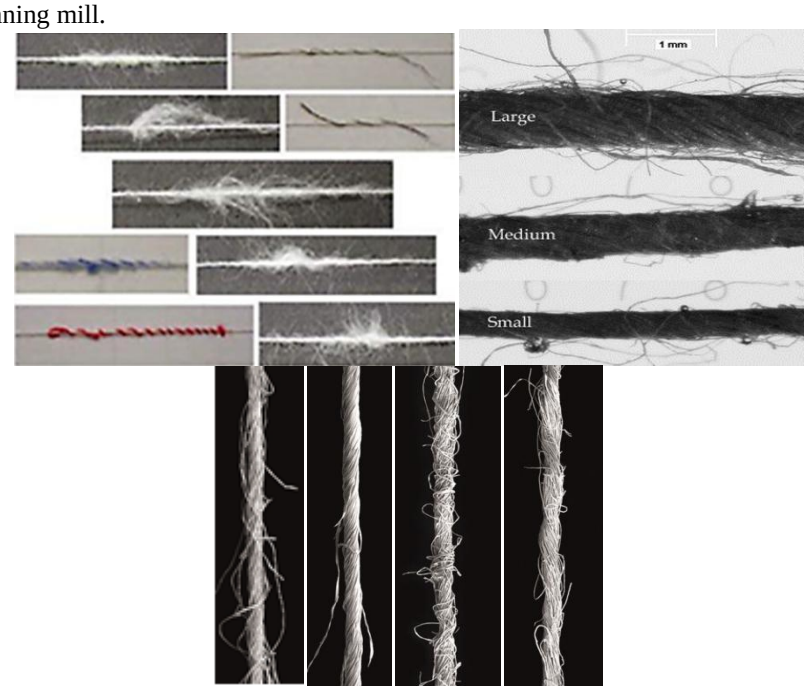

Fig. 26 Diagram of Yarn faults

5.7.4 Yarn clearing concept of Uster Quantum clearer

Yarn fault is divided into different classes according to their length and cross sectional size. The yarn fault length is measure in centimeters and cross sectional size is measured in percentage. The classes and there limits are set as below points.

- Short thick places fault contains 16 classes with the limits 0.1 to 8 cm for the length and the cross sectional size are +100% to +400%. The classes are indicating A1 to D4.
- Spinner's doubles fault lies in E class fault, whose length is over 8 cm and cross sectional size is over step to +100.
- Long thick places fault and thick ends fault have four classes. Yarn fault length is referring to be 8 cm to 38 cm and cross sectional size is -30%, -45% and -75%. The classes are designated H1, H2 and I1 and I2.

N means Neps
S means short fault

L mean long fault
CCP mean coarse count
CCM means fine count

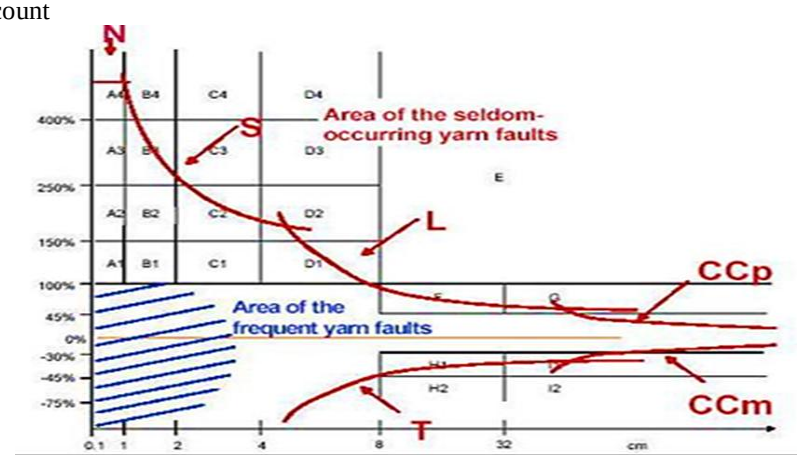

Fig. 27 Diagram of Yarn fault classes

V. CONCLUSION

In our paper, we have achieved a lot of defects regarding to process problems during manufacturing of yarn in different departments. First we have discussed all problems that can occur in the process, then at the same time we have also gave a preventive action for those problems. We have also highlighted the critical success factors of every department that can cause more dangerous in quality point of view and improvement of process.

After the participation and share knowledge from our three applicants, the conclusion of our paper is to highlight the issues in the manufacturing process. It is a good experience for us and gained a technical knowledge from it. Actually the report which we have written is the mixture of analysis and our practical experience and in this technical and advanced world, it is necessary to work in a systemic way and try to improve financial condition of the organization.

In our opinion, the paper which we have written is very useful for yarn manufacturing plant. In textile industry, especially in yarn manufacturing plant (Spinning Plant) there are seven big departments and it's difficult to achieve the objectives in every department without implement of suitable system in the process. As our practical experience in yarn manufacturing plant, it is very necessary to reduce or eliminate the defects in ever department to achieve the required specification of customers in the final yarn end product. For capture market in these days and from customer's requirements, product should have a good product of quality and service.

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