Study Material for
Diploma Course in Haryana

Branch

Textile Technology

(Semester-III)

Subject

Spinning Technology-I

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UNIT I

Ginning, Mixing, and Blending

1. Ginning

Cotton Ginning is the process of separating the cotton fibers from the cotton seeds. Perfect ginning operation would be performed if the separation of fibers from seed was affected without the slightest injury to either seeds or to the fiber. A cotton gin is a machine that quickly and easily separates the cotton fibers from the seeds, a job previously done by hand. These seeds are either used again to grow more cotton or, if badly damaged, are disposed of. It uses a combination of a wire screen and small wire hooks to pull the cotton through the screen, while brushes continuously remove the loose cotton lint to prevent jams. The term "gin" is an abbreviation for engine and means "machine".

1.1 Objects of ginning

- To remove the fiber from the seed.
- To remove the neps and wastage to some extents.
- To collect the seed and seedless cotton fiber separately.
- To separate the cotton fiber from the root position of the seeds

1.2 Ginning Machine

Saw Gin and Roller Gin are the two popular methods; both can be employed for short and medium staple varieties. Even though the ginning percentage is higher, the neps are produced in Roller Gin. The Saw Gin, however, tends to damage the fibers owing to forceful blows of saw teeth during detachment of the fibers. Macarthy Gin is another type of gin which is slow in its working and hence production rates are comparatively much lower. However, the operation is gentler and hence it can be beneficially used for long staple cotton.

1.2.1 Saw ginning

The saw gin mainly consists of saw gin discs placed on a shaft. Each disc is approximately 12 inches in diameter and spaced at a distance ¾ inch. A rib is a curved plate with appropriate slots just enough for some portion of the saw teeth of each of the discs to project through in the upward direction as shown in **Figure 1**.

The seed cotton is fed by the feed lattice which is situated above the saw tooth discs. The material before entering the disc zone is treated by a pair of guide rollers and a spiked cylinder, both having spikes on them. The hopper receiving this material finally leads the seed cotton to the actions of saw tooth discs. The teeth of each saw tooth disc pick up small portions of fibrous matter attached to the seed, pluck it off and take it through the rib slots. The seeds, being greater in size than the rib-slots, are not able to follow this path and remain at the top of the rib. As the rib is slanting downwards, when the fibers are detached by the sharp teeth, the seeds eventually fall down and are collected in the seed box situated below.

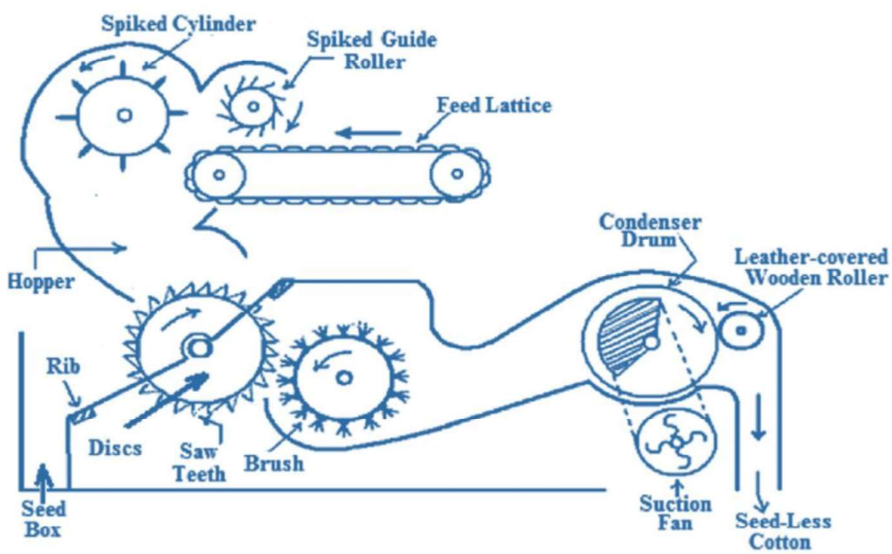

Figure 1. Schematic diagram of saw ginning machine.

As mentioned earlier, the rib slots are just sufficient for the discs to freely rotate, and thus the tiny mass of the fibers plucked from the seed cotton is easily able to pass along with the saw tooth points of discs through this gap. The fibers are brushed off subsequently by a fast-rotating brush about 18 inches diameter and with its bristles touching the saw tooth points of discs. Finally, a strong stream of air is made to sweep the brush and carry loose fibrous lint on to the condenser. The suction is created inside the condenser, and it helps to direct the flow of lint on its surface.

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2. Sorting

The meaning of Sorting is “To examine in order to clarify”. Similarly in Spinning, there is a sorting section in the start of process. In the sorting section, heavy impurities like leaves, Sutli, Birdwings, Paper, Plastic, Wood, Yellow cotton bunches, etc. are removed from cotton. These impurities are known as contaminations. If these are not removed in the starting process, then it causes serious damage to the machines.

2.1 Objects of sorting

1. It removes the heavy impurities like leaves, Sutli, Birdwings, Paper, Plastic, Wood, Yellow cotton bunches, etc.
2. It helps to prevent serious damage to the machine.
3. To achieve processing performance.
4. Sorting removes impurities and defects from the cotton, which results in yarn that is stronger, more uniform, and more consistent in color.
5. Sorting reduces the amount of time and labor required to prepare the cotton for spinning, which can lead to increased productivity.
6. Sorting helps to ensure that the cotton is used efficiently, which reduces waste.

3. Mixing and blending

3.1. Mixing: If different grades of same fibers are kept together, then it is called mixing.

3.2. Blending: When different fibers of same or different grades are kept together, then it is called blending.

3.3. Importance of mixing and blending

1. Important of processing performance

2. Development of newer usage

3. Minimization of cost

4. To give the required characteristics to the product.

5. Availability of stock

3.4. Mixing techniques in blow room

1. Volume mixing: Here, volumetric is performed. Cotton fibers of different quality falls into the mixing bin and the bins are filled in different volume by pneumatic air. Thus mixing is done.

2. Weight mixing: In weight mixing, different quality cotton fibers are weighted first and then they are mixed in different weight (gm).

3. Hand mixing: This method is an old type of mixing. Normally used to produce higher count yarn. This mixing is done entirely with the help of hand.

4. Bin mixing: In bin mixing, cotton flocks are transferred from the bale opener into pipeline. The pipeline diameter is 10 inches, and it passes over the bins, fibers flocks are delivered into the bins from the delivery boxes of the pipe placed in the pipe.

5. Lap mixing: In lap mixing, double scutcher is used. One is breaker scutcher and another one is finisher scutcher. Different grades and different quality laps are produced in the breaker scutcher. Four lap stands are placed before the finisher scutcher.

6. Automatic mixing: In this method, cotton fibers are mixed automatically by different automated machines without breaking bales manually. Here, the number of bales is placed both side of the machine longitudinally. The machine moves in traversing motion and extract the fiber from the bales into the duct for mixing. For example-unimix of reiter

3.5. Blending techniques from blow room to draw frame

Blending can be carried out at various process stages, by using various methods, equipment, machines, and intermediate products. The following can be distinguished:

Blending type	Process stage

Flock blending	within the blow room
Lap blending	by using scutchers
Web blending	at the ribbon-lap machine or the blending draw frame
Sliver blending	at the draw frame, the sliver-lap machine (or the comber)
Fiber blending	at the card or the OE spinning machine
Roving blending	at the ring spinning machine

3.5.1. Flock blending

This is already substantially finer than mixing bales and is becoming steadily more important because of the use of automatic bale-opening machines (not always a sufficient number of bales in the mix). Flock blending takes place in an uncontrolled manner, inevitably and to a small degree, at each blowroom machine.

3.5.2. Lap blending

This is hardly used now but was previously used occasionally, e.g., for blending cotton with man-made fibers. A doubling scutcher is required in this case; this has a conveyor lattice in the infeed on which four to six laps (L) could be laid (**Figure 2**), and jointly rolled-off. The lap-sheets from these laps passed doubled through a beater position followed by a pair of cages and a lap-winding device.

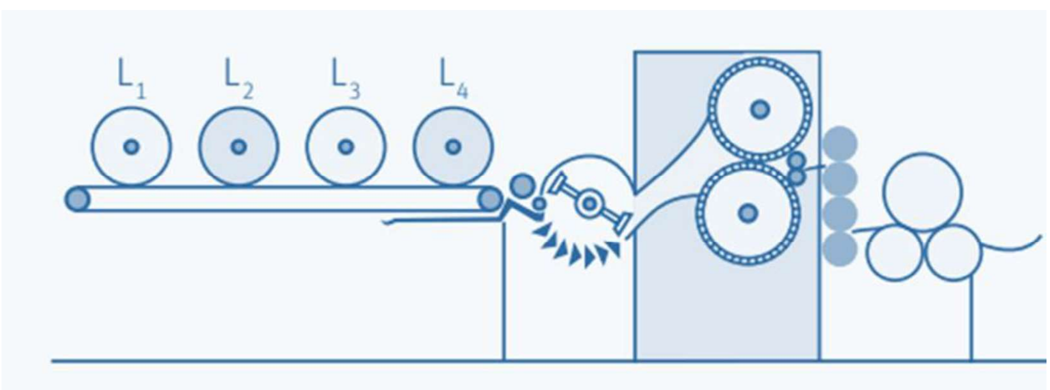


Figure 2. Lap blending on an old scutcher.

3.5.3. Web blending

Web blending (Fig. 33) has been used for a long time at the ribbon-lap machine, admittedly not to bring together different components but rather to provide a very even lap as feed material for the comber. Another development was a draw frame which enabled controlled blending to be achieved by bringing together components in web form (after drafting on four drafting arrangements), instead of doubling in sliver form. This gives a good longitudinal blend and also a slightly better transverse blend than is obtained with sliver blending.

3.5.4. Sliver blending

For the most part, blending of natural and man-made fibers is still carried out in sliver form on the draw frame. This provides the best blend in the longitudinal direction.

3.5.5 Fiber blending

Without any doubt, the most intimate blend is obtained if individual fibers are brought together. This can be achieved only on the cotton card (to a small degree), on the woolen card (sometimes intensively), and in rotor spinning (over short lengths only).

3.6 Comparison of mixing and blending

S.No.	Blending	Mixing
1	Mixing of different fibers e.g., P.C. blends	Mixing of same fibers e.g. mixing of American cotton with Indian cotton
2	Same properties of fiber are used in blending	Different properties of fiber are used in mixing
3	In blending, quality is not so much considered.	In mixing, quality of fiber is considered
4	All the characteristics of fiber are known in this process	All the characteristics of fiber are not correctly known in this process.

EXERCISES

Multiple type of questions

1. Fiber mixing occurs in

a. Blow room

b. Carding

c. Draw frame

d. Speed frame

2. Flock mixing done in

a. Blow room

b. Carding

c. Draw frame

d. Ring frame

3. Web mixing done in

a. Ribbon lap

b. Carding

c. Roving frame

d Draw frame

4. Blending is a mixing

a. Same properties with same fiber

b. Same properties with different fibers

c. Same color fiber with same fibers

d. Different length of fiber

5. *Generally, impurities (%) present in cotton bales are*

a. 1-2

b. 5-10

c. 15-20

d. 20-25

7. largest impurities present in raw cotton are

a. seeds

b. dirt

c. chaff

d. micro dust

Very short answer type of questions

1. What is mixing.

2. What is blending?

3. Define ginning.

4. What is flock blending?

5. What is sliver blending?

6. What is sorting?

Short answer type of questions.

1. Write the difference between mixing and blending.

2. Write the objects of sorting.

3. Write the advantages of mixing and blending.

4. Write the objective and type of blending.

Long answer type of questions.

1. Explain the working of saw ginning with neat sketch.

2. Write short note on:

a. Blending

b. Mixing

UNIT II

Principles of Opening, Cleaning, and Other Principles Used in Blow Room

2. Types of feed

In the context of a blowroom in spinning line the terms "loose feed system," "fast feed system," and "semi-fast feed system" refer to different methods of feeding fibers into the blowroom machine.

2.1. Loose feed

Loose feed techniques are employed in the initial cleaning line so that heavy impurities are removed, otherwise they will be crushed into fragments while fed into gripped feeding through pair of feed roller and it is very difficult to remove crushed impurities. In a loose feed system, fibers are fed into the blowroom machine in a relatively loose manner. The raw material, such as cotton bales or synthetic fibers, is typically manually or mechanically opened and spread onto a conveyor belt or feeding chute. The fibers are loosely transported to the blowroom machine, where they undergo further processing, including cleaning, mixing, and opening.

Example: Vertical opener, step cleaner, mono cylinder, S.R.R.L. Ope ner,Axiflo cleaner, etc.

2.2. Semi fast feed system

The semi-fast feed system falls between the loose feed system and the fast feed system in terms of the feeding speed and control. It involves the use of feeders that offer intermediate feeding rates. These feeders can handle a moderate amount of fibers and provide a relatively controlled flow. The semi-fast feed system offers a balance between production speed and processing control, making it suitable for certain applications where a moderate feeding rate is desired.

Example: Porcupine opener, 3 bladed beater, ERM cleaner,etc.,

2.3. Fast feed system

In a fast feed system, fibers are fed into the blowroom machine at a higher rate compared to the loose feed system. This system involves the use of automatic or semi-automatic feeders that can handle a larger volume of fibers. The feeders are designed to deliver a continuous and controlled flow of material to the blowroom machine. Fast feed systems are commonly employed to increase the production capacity and efficiency of the blowroom process.

3. Difference between beating and opening

In spinning systems, "beating" and "opening" are two distinct processes that occur at different stages of fiber processing. Here's an explanation of the difference between beating and opening:

3.1. Opening

Opening refers to the initial process of separating and loosening the compacted fibers in a fiber mass. It is typically the first step in the blowroom line of a spinning mill. The primary objective of the opening process is to create a more uniform and homogeneous fiber mass by separating the fibers from each other and removing any foreign matter or impurities. Opening is achieved through mechanical means, such as the use of beaters, sawtooth blades, or spiked lattices, which agitate the fiber mass and break apart any clumps or entanglements. The opened fibers are still relatively long and retain their individual characteristics.

3.2. Beating

Beating, on the other hand, is a subsequent process that occurs after the fibers have been opened. Beating involves subjecting the opened fibers to a more intense mechanical action to further separate and refine them. The main objective of beating is to break down the fiber clumps into smaller individual fibers, enhancing their carding and subsequent processing efficiency. Beating is achieved using specialized machinery, such as beaters or carding machines, which incorporate rotating elements with pins, wires, or teeth that comb and strike the fibers. The beating action disentangles and aligns the fibers, ensuring a more uniform distribution and preparation for subsequent spinning processes.

To summarize, opening focuses on separating and loosening the compacted fibers, while beating concentrates on further breaking down the fibers into smaller, individual elements. Both processes are crucial in the preparation of fibers for spinning, ensuring better fiber quality, improved blending, and enhanced processing efficiency.

4. Types of beaters

There are mainly three types of beaters used in blowroom and they are explained below:

1. Porcupine
2. Bladed beater: Beater arms (Multiple bladed beaters)
3. Kirschner beater

4.1. Porcupine

The strikes are arranged at different angles to cover the total width of the machine in one revolution of the beater. Good opening beater and suitable for long staple cotton. It separates the fibres by the striker. Simultaneously cleaning is also done.

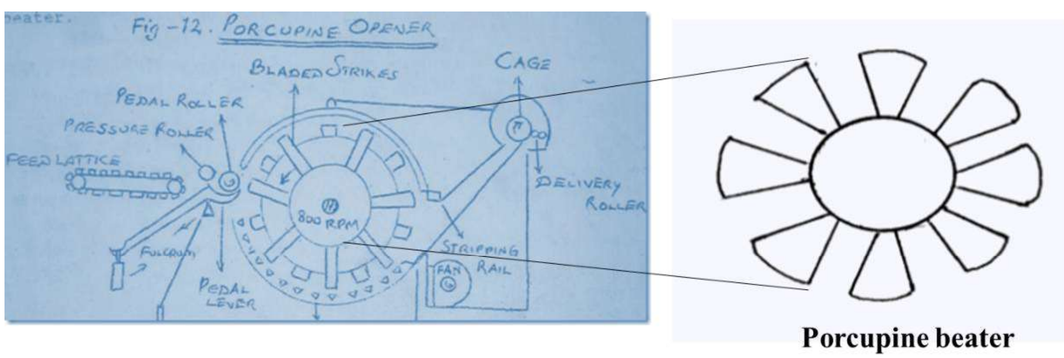


Figure 1. Porcupine beater

4.2. Bladed beater: Beater arms (Multiple bladed beaters)

The beater bars arranged parallel to the supporting shaft and held by four or five cast-iron arms. Opening and cleaning effect this type of beater is small. It is hardly found a row; it is only in the form of the double beater scutcher.

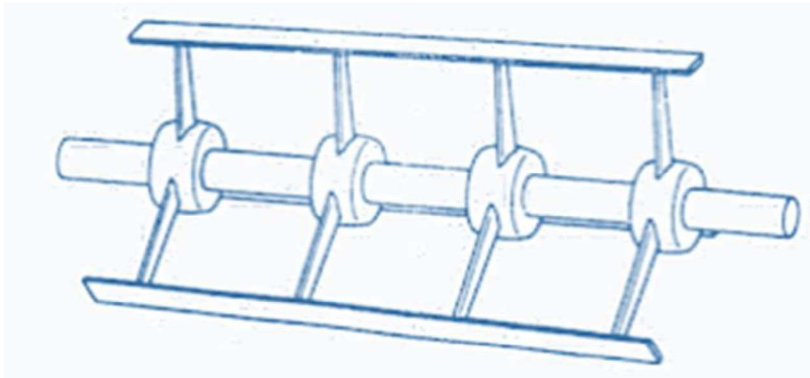


Figure 2. Multiple bladed beater.

There are two types of multiple beater

1. Two bladed beaters
2. Three bladed beaters

4.2.1. Two bladed beaters

1. Two bladed beater are arranged in both sides and equal distance of shaft.

2. Revolution per minute 800-850.

3. To clean broken seeds or heavy impurities of fibers.

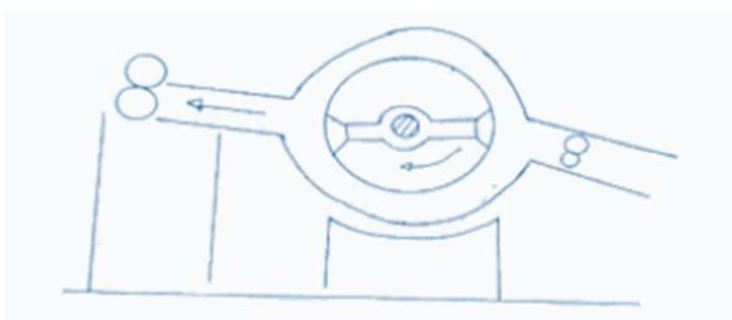


Figure 3. Two bladed beater

4.2.3. Three bladed beaters

Similar to two bladed beater, three bladed beater arranged in an equal distance of shaft. Clean darts like two bladed beaters but are more effective RPM of three bladed beater 850-940.

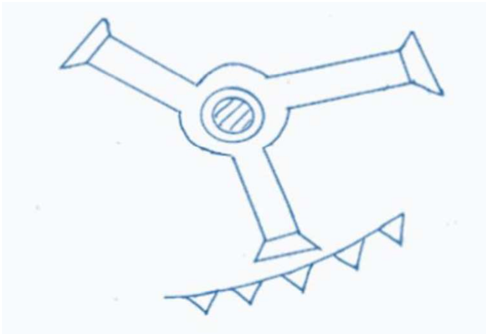


Figure 4. Three bladed beaters

4.3. Kirschner beater

In this type of beater, instead of beater bars, pinned bars (pinned lags) are secured to the ends of the cast-iron arms. The relatively high degree of penetration results in a good opening. Kirschner beaters were therefore often used at the last opening position in the blow room line. Modern Kirschner openers are often designed as closed rollers rather than three-armed beater units. The design is simpler and the flow conditions are more favorable.

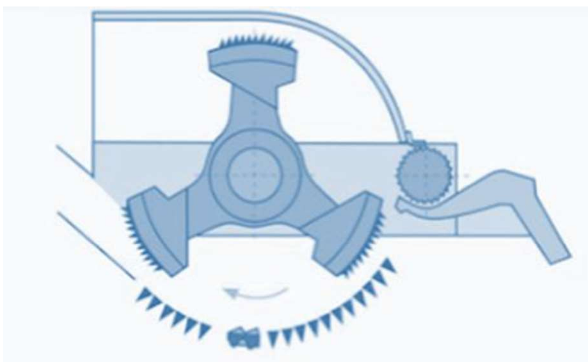
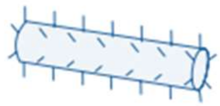
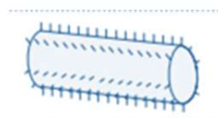
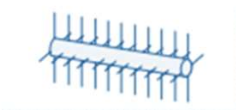
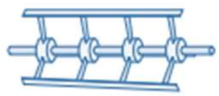
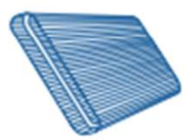
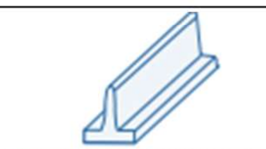


Figure 5. Kirschner beater

5 Types of spikes, nails, beater used in blowroom

In a blowroom, various types of spikes, nails, and beaters are utilized for different functions (**Table 1)**. the specific types of spikes, nails, and beaters used in a blowroom may vary depending on the machine manufacturer, design, and the desired process requirements. Different combinations of these elements can be employed to achieve optimal fiber opening, cleaning, and preparation for subsequent processing stages.

Table 1. Types of spikes, nails and beaters

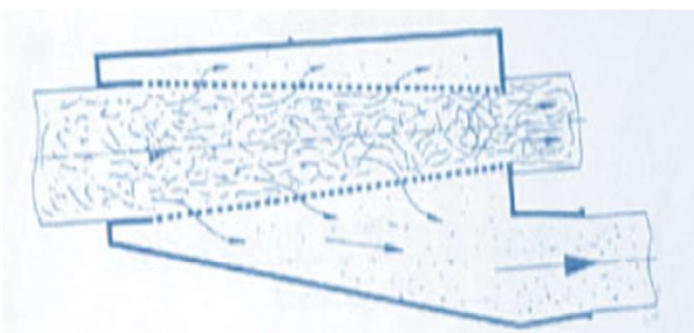
Types of spikes, nails and beaters	Appearance	Description
Rollers		Small diameter, widely used, e.g. in step cleaners.
Drums		Larger diameter, e.g. in the mono-cylinder cleaner.
Quilted shaft		Shaft with many long beater rods, hardly used.
Multiple blades beaters		Two, three, or more arms. Now used only in old blowroom lines.
Spiked lattice		Endless belts with transverse woo□den or plastic bars in which needles are set, gives very gentle opening.
Picker		In the bale picker and blending grab (both outdated).
Carding bars or plates		The devices associated with the carding drums of the card.

6. Principle of dust, dirt and fly extraction

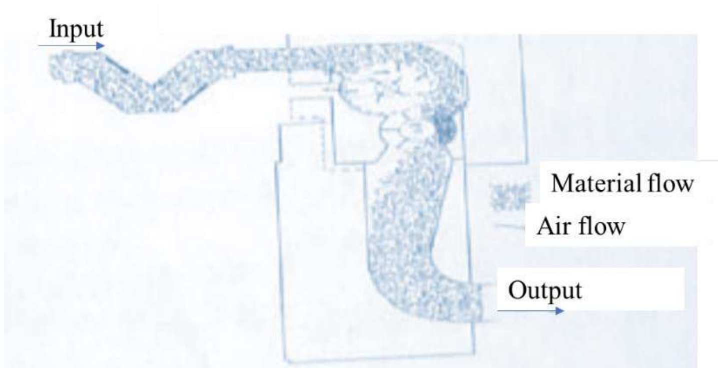
Dust and micro dust are the finest particles of trash. Their removal takes place at various stages in the blow room. Two techniques are mostly used for the removal of the dust.

1. By separating the fibers and releasing the dust into air, this is then removed by removing the dust contaminated air. The release of dust occurs whenever the fibers are rolled, beaten or opened up. In this type of arrangement, it's not only important to remove the dust contaminated air but also extremely important to maintain a dust free atmosphere in the blow room.
2. By separating the dust particles directly from the fibers through suction and scraping. This arrangement is better as compared to the first one as the chances of dust flying in the atmosphere are not present. Many different techniques are used to separate the dust from the fibers, most common ones are:
   1. Use of perforated drum
   2. Use of stationary perforated surface
   3. Circulating perforated belts
   4. Stationary combs

The perforated drums and perforated surface are the most commonly used techniques for dust removal. For example, in the following diagram a Reiter dust extractor is shown that makes use of stationary perforated surface.



In the following Trueutschler dust extracted is shown that make use of rotary perforated drum.



Here the incoming material is drawn on a perforated drum with the help of air stream. This air stream is then removed by using a high vacuum exhaust for the drum perforation using a suction fan. By doing so, fine dust also gets removed along with air. The fibre material is stripped off the perforated drum with the help of a paddle roller. The stripped fiber material is then transported to next stage with the help of suction provided at that end.

7. Principle of air current for dust removing

Lighter impurities like dust and micro dust cannot be removed from the fibers by using either the spiked surface or beater. These impurities can be removed by passing the fibers over the perforated grid where the air currents can draw off the dust in their fibers.

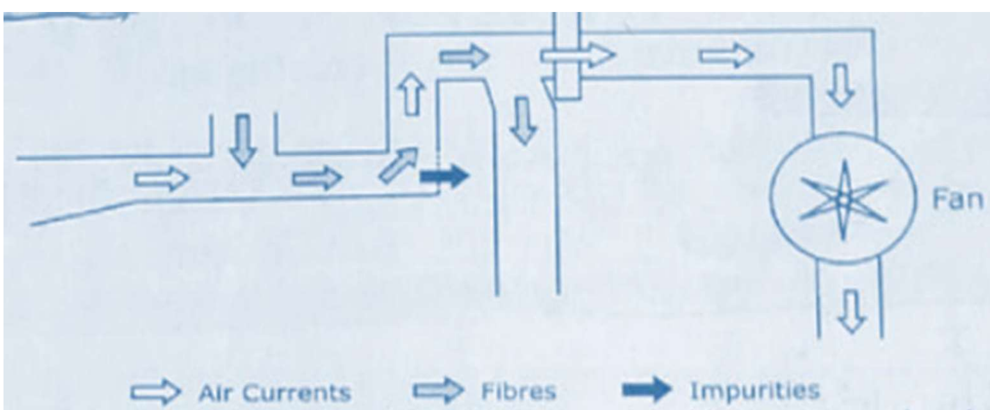


Figure 6 Principle of air current for dust removal

All the above and the majority of the operating devices in the blow room machinery are opening devices when they are used alone. However, these very same devices can also work as cleaning devices if they are worked in cooperation with the following element can be used in girds:

1. Slotted sheets
2. Perforated sheets
3. Triangular section bars
4. Angle bars
5. Blades

These elements can either be used alone or in combination with each other. For example, perforated and slotted sheets were widely used and placed under the cards but now their use is diminished. Same is the case with the blade grid that were used in combination with the triangular bars grids.

7.1. Multifunctional separator and by pass arrangement

A multifunctional separator and bypass arrangement is a system commonly used in blowrooms to enhance the efficiency of fiber separation and handling. This arrangement allows for multiple functions to be performed simultaneously, improving productivity and processing flexibility.

1. Multifunctional Separator

The multifunctional separator is a machine in the blowroom that integrates various operations into a single unit. It is designed to perform functions such as opening, cleaning, and blending of fibers. The separator utilizes different mechanisms, including beaters, spikes, or grids, to achieve these tasks. By combining multiple functions, it reduces the number of machines required and optimizes space utilization.

2. Bypass Arrangement

The bypass arrangement is a feature incorporated into the blowroom system that allows for selective diversion of fibers without going through the complete processing sequence. It provides flexibility to divert fibers to alternative paths for specific treatments or to bypass certain machines when not required.

8. Description and working of condenser

For the transportation of the fibers from the blow room to the card the chute feed system is used at Spinning Mills. In the chute feed system the ducting pipes and the chute are used. The fibers are taken from the last roller through the condenser, which creates suction and then feed them to the card machine.

The condenser is very important part of the blow room. Its main function is to take the fibers from the back part and supply them to the next part. All this operation is down on the bases of the sucking function of the condenser.

Basically, the condenser consists of a fan, stripping roller and a perforated roller. The fan is connected with a high-speed motor, which rotates it at a high speed. The grid roller has holes on its surface, which helps it to suck the fibers from the back machine. When the fan and the grid roller rotates with the help of the motor, an air vacuum is generated which sucks the fibers from the back rollers through the holes of the grid roller. The stripper roller removes the fibers from the perforated roller and through them into the chute.

EXERCISE

Multiple choice type of question.

1. Opening and cleaning is done by

1. Ring frame 2. Blow room

3. Roving frame 3. Winding machine

2. The feeding of material in the Step cleaner is done as a

a. Loose feed b. Fast feed

c. Semi fast feed d. none of the above

3. ………..the output of blow room

a. lap b. sliver

c. roving d. yarn

4. Different types of beater used in …

a. Blow room b. Ring frame

c. Roving frame d. Draw frame

5. 1 hank is equal to …

a. 840 yard b. 1 meter

c. 12 feet d. 140 yard

Very short answer type of questions.

1. What is opening?

2. What is beating.

3. What is spinning?

4. Name the beater used in blow room.

5. What is condenser in blow room?

Short answer type of questions

1. Write short note on loose and fast feed system.

2. Write the difference between beating an opening.

3. Write short note on various types of beaters used in blow room.

4. What is two bladed beaters?

Long answer type of questions.

1. Write the description and working principle of condenser.

2. Explain the various type of beater used in blow room with neat sketch.

3. Write the principle of opening and cleaning.

UNIT III

Blow room

1. Blow room

In cotton spinning, the "blow room" is the initial stage of the process where raw cotton fibers are prepared for further processing into yarn. The primary purpose of the blow room is to open up the compacted cotton bales, clean the fibers, remove impurities like dust, dirt, and short fibers, and create a uniform web of cotton fibers suitable for subsequent processing.

1.1.Objects of Blow room

1.1.1. Opening: The tightly packed fibre bales received from the ginning mills have to be open by converting the larger fibre tufts into smaller ones and ultimately converting the smaller tufts into individual fibre from.

1.1.2. Cleaning: After opening, the cotton goes through various cleaning processes to remove impurities such as dirt, dust, leaf matter, and short fibers. Machines like cleaners, beaters, and aspirators are used for this purpose.

1.1.3. Mixing/Blending: The properties of the cotton fibres from each other from bale to bale and from fibre to fibre so in order to obtain a homogenous and consistent quality yarn, they need to be thoroughly mixed together, sometimes in order to have a desired quality at the right price quality cotton fibres are mixed with the low quality fibres.

1.1.4. Preparation of feed for the next stage: The end product of the blow room should be compatible with the next stage of spinning i.e., carding. The feed to the carding can be either given in the form for lab or in direct form of fibre.

1.2. Blow room machinery

In the blow room all the above functions have to be fulfilled for this purpose various different types of machine are used based on the functionality of these machines they are classified in to five types.

1. Bale opening machine
2. Mixing machine

3. Cleaning machine
4. Dust removing machine.
5. Recycling machine

For these machines to perform optimally, they must be located at a specific position in the blow room line. The modern cotton blow room line can be divided into six distinguished zones.

1. Bale opening zone.
2. Coarse opening and cleaning zone
3. Mixing/blending zone
4. Fine opening and cleaning zone
5. Intense opening and cleaning zone
6. Card feed preparation zone

In case the cotton has less impurities then the ZONE 5 (intense opening and cleaning) may not be necessary.Furtemore the ZONe 4 or the ZONE 5 and the ZONE 6 can form a single unit.

1.2 ZONE 1 (Bale opening machine)

After proper bale lay down the initial bale feeding is done either by using a parallel set of machines called hopper bale feeders or by single machine called automatic bale plucker. The hopper feeder has stock supply compartments which are either filled or by automatic machines. A cross sectional diagram of typical hopper feeder is shown below. The hopper feeder still used in quit sophisticated from however they are considered to be conventional type of bale opener. They remain stationary while the raw fibres from the bale can be fed manually or by automatic machines.

1.2.1 Hopper bale breaker

In old, conventional blow room, Hopper Bale Breaker assumed a lot of importance. It is, as the name suggests, the first machine in the conventional set-up that is used to tackle the hard-matted mass of bale cotton. The machine, therefore, has been made quite sturdy, strong and robust in its construction.

The long creeper lattice (Fig. 1) receives lumps of cotton from the bales. All the bales are laid around this lattice. A tenter is instructed to take smaller slabs of cotton from each of the bales in turn. The creeper lattice moves very slowly and subsequently delivers the material onto the feed lattice which is situated at the base of a large hopper or bin.

The feeding is adjusted in such a way that the hopper formed above this lattice always remains about three-quarter filled with cotton. The feed lattice brings the cotton slabs very close to a faster-moving inclined spiked lattice. The spikes on this lattice pick up the small tufts from the slabs of the compressed mass of cotton brought ahead by feed lattice and carry them upwards.

Almost at the top, there is a roller covered with similar set of spikes and is called Evener Roller. The direction of the rotation of this roller is opposite to that of the spiked lattice. So also, the spikes of this roller are set very close to those of spiked lattice. This sets in a slicing action.

The spikes of evener roller slice any extra mass of cotton that is carried by the spikes of inclined lattice. This results in great reduction in the tuft size. The tufts thus reduced in size are carried further and around by the spiked lattice. The distance ‘d’ between the spikes of evener roller and inclined lattice is adjustable. The narrower distance allows only smaller tufts to be retained by inclined lattice. It may be mentioned here that the rate of production of this machine largely depends upon this distance. The wider setting allows bigger tufts to pass through. However, this reduces the opening action. Therefore, for increasing production rate of this machine, the tuft-opening action at evener roller has to be sacrificed.

The excess of cotton sliced by the evener roller is returned back to the hopper. It may be possible that some of the tufts do not simply fall back into the hopper as they are retained by evener spikes. For this, there is another roller called stripping roller, which is made to strips the evener spikes continuously. The flaps of stripping roller ensure that the cotton thus swept falls back into the hopper.

With slicing action of evener spikes, when excess material is sliced-off the spikes of inclined lattice, some material is still withheld by inclined lattice spikes. The spikes on the lattice take this material which is appreciably reduced in tuft size, ahead through the gap between evener roller and spiked lattice. So also, it is equally likely that some of the tufts originally picked up by the spiked lattice are very small. They pass through the gap unharmed. In either case, the tufts which ultimately pass through the gap are finally stripped-off by another beater called leather flap beater. The speed with which this beater swipes the cotton tufts from the spikes of inclined lattice gives a whipping action to the cotton. The cotton tufts are not only removed from the spikes but, in the process, are also thrown over the grid bars. The mere force with which the cotton is struck against these grid bars forces some of the released impurities to pass through the small openings of grid bars. The cotton fibremass, being bigger in volume, is not allowed to go through these gaps so very easily.

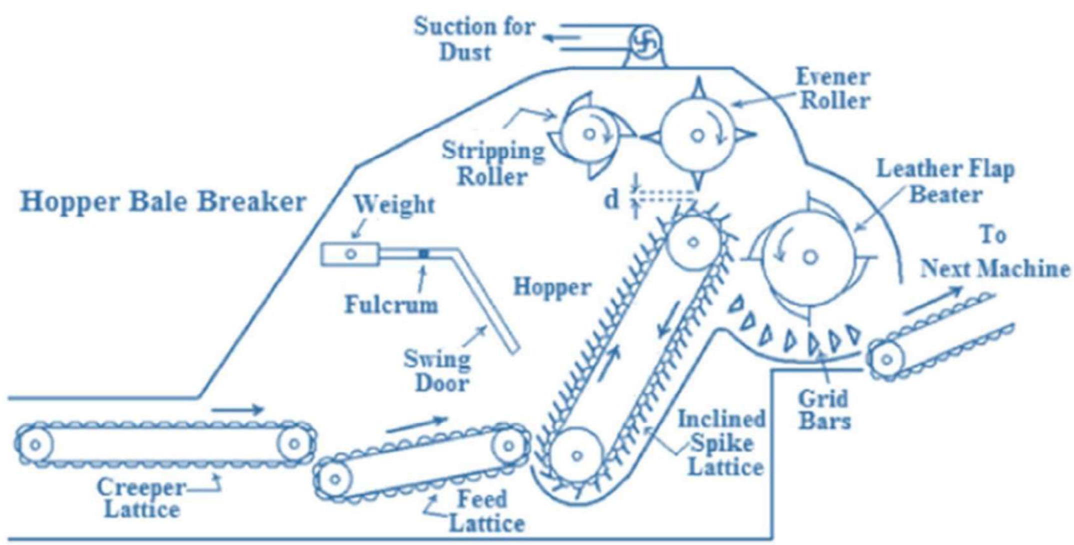


Figure 1 Passage of cotton through Hopper Bale Breaker: The machine used to be placed in the beginning to open-out compact and matted mass of Bale Cotton.

A suction fan is placed above the action zone of evener roller and stripping roller. Normally, owing to the action between the spikes of evener roller and inclined spike lattice, so also due to the stripping action of stripping roller, there is a lot of fly and fluff generated around this region. The fan rotating at quite a high speed helps in sucking away the flying, floating short fibres and dust. The suckedout material is carried away and is finally deposited into cellar or filter unit. As mentioned earlier, the production of this machine can be varied by altering the setting between evener roller and inclined lattice. However, a better way to increase the production is to speed-up inclined spike lattice. In this case, the quality does not suffer. For normal settings, the production varies from 3300 to 3500 kg per shift.

Nowadays the most popular and modern machine for feeding raw fibres from the bale is the top feeder (Automatic bale plucker). In the following figure 1, the Reiter unifloc automatic bale opener is shown in figure 2.

1.2.2 Automatic bale plucker

The automatic bale opener are travelling machines that move over and past the bale layout and extract fibres from top to bottom. They have great advantage that more than one bale can be processed simultaneously to give a better long-term blend. These machines are fitted with computerized control panels and they extract material from all the bale evenly. The production rates of such modern bale plucker ranges from 750 kg/hr to 1000 kg/hr.

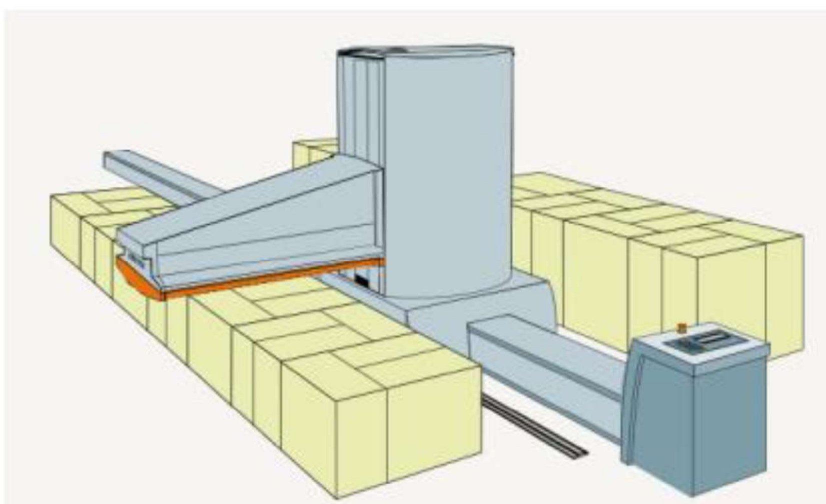


Figure 2. Automatic bale plucker

The hopper bale opener and automatic bale plucker perform the following functions:

1. Pluck the material evenly from bale
2. Open the material gently.
3. Open to smallest tuft
4. Form tufts of equal sizes
5. Process as many bales as possible in a single charge

6. Easily programmable
7. Blend fibres at the start of the process

1.3. ZONE 2 (Coarse cleaning machine)

The coarse cleaning machine directly gets it feed from the hopper feeders or from top feeder. The striking and beating elements in this zone are widely spaced and the opening of the fibres is also very minimal. The main purpose of these machine is to open up to the mass fibres into large tufts which are then converted into smaller tuft by using more intense opening and cleaning machines in the next zone. The machine in these zones is sometimes not even fitted with cleaning devises or even if these cleaning devices are present, they can remove fraction of the impurities. Different machine manufacturers have developed various types of coarse cleaning machines. The most used ones are:

1.3.1. Step cleaner

The material falls into the feed hopper and passes to the first beater. From there it is transported upward by the six (sometimes three or four) beater rollers, each carrying profiled bars; the beaters are arranged on a line inclined upward at 45°. Elimination of impurities takes place during the continual passage of the material over the grids arranged under the rollers (Fig. 46). Some step cleaners have a high flow chamber with special baffle plates (a) to improve cleaning intensity. The grids are always adjustable and usually also beater speed.

The machine comprises a large cleaning chamber containing two drums of 610 mm diameter rotating in the same direction. A fan downstream from the dual roller draws material through the machine by suction. The first opening roller carries the material over the grid three times before it passes to the second roller. Trash falls onto the bucket wheel locks. Guide sheets in the hood direct the tufts.

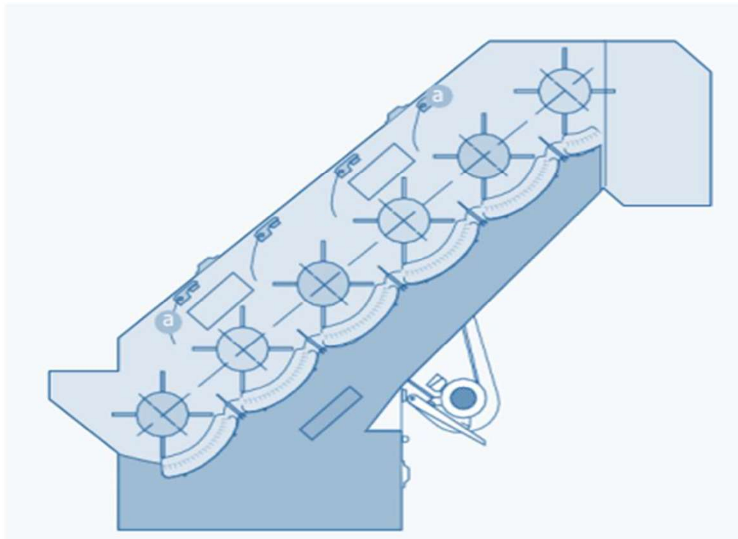


Figure 3. Step cleaner

1.3.2. Mono cylinder (Uni-cleaner)

This machine operates in a similar manner to the dual roller cleaner but has only one drum. The material enters the machine at one side and flows through (parallel to the beater) to the other side. In order to prevent tufts from being drawn straight through the machine, the large hood above the drum is divided into three chambers by guide plates. This causes the tufts to fall back into the region of the beater drum after being hurled out by the roller. In this way, the tufts are forced to circulate three times with the drum, i.e. pass three times over the grid; this produces an intensive cleaning effect. The grid is in two parts, and these are separately adjustable.

The basic design corresponds to that of the mono cylinder cleaner, i.e., there is an inlet duct (4), a large cleaning drum (1) with special hooks, a waste suction device and an outlet duct (5). But instead of the material rotating three times inside the machine, it is forced to pass over the grid five times, always presenting new surface areas to it. The tufts not only pass over the grid five times, they also pass over a specially arranged perforated sheet five times. The chamber behind this sheet is a low-pressure chamber. The air suction through this sheet provides very efficient dedusting. The waste is collected inside the machine and fed to the waste transport via an airlock cylinder. Intermittent suction and connection to continuous suction is possible. The airlock prevents good fibers from being sucked through the grid during waste removal.

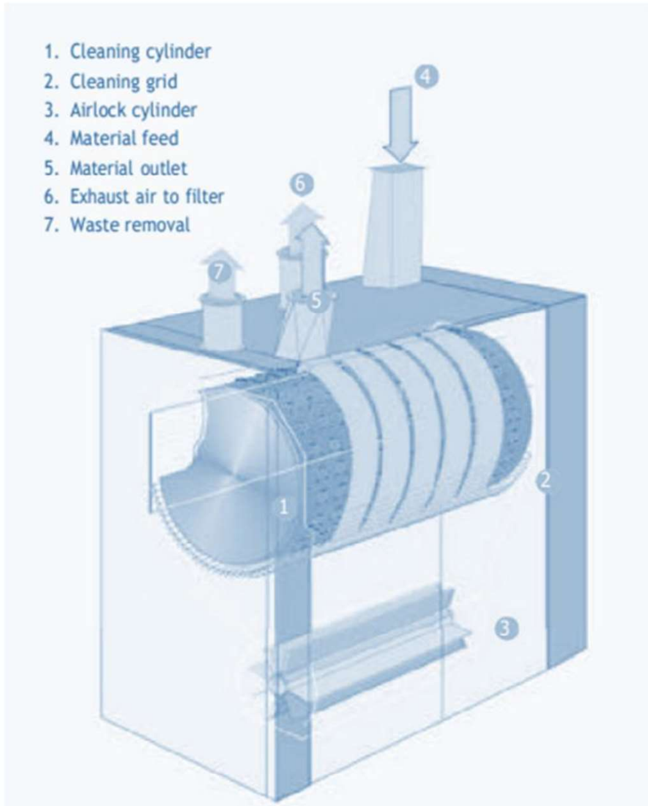


Figure 4. Uni- cleaner or Mono-cylinder

1.4. ZONE-3 (Blending/Mixing machine)

**1.4.1. The Multimixer **

The machine (Fig. 5 a) comprises several (6 - 8) adjacent chute chambers into which the material is blown from above. The chutes are filled successively, and material is removed from all chutes simultaneously. This gives a good long-term blend. Ejection of tufts onto a collecting conveyor is performed by take-off and beating rollers under the chutes. The filling height in the chutes is held constant by sensors. At the end of the machine a simple suction system or a cleaner can be incorporated.

1.4.2. The Unimix

The machine (Fig. 52, Fig. 53) is made up of three parts: a storage section, an intermediate chamber and a delivery section. Tufts are fed pneumatically and simultaneously into eight chutes (Fig. 5b) arranged one behind the other in the storage section. A conveyor belt feeds the stock through the intermediate chamber to the spiked lattice (3). The material columns are thus diverted from the vertical into the horizontal. In addition to a condensing effect, this 90° deflection in the material flow also produces a shift in the timing and spatial distribution of the fiber packages from the first to the last chute. This special construction with a deflection of 90°, and thereby different distances from the individual chutes to the lattice (at chute 1: short distance; at chute 8: long distance) in turn results in good long-term blending. Thereafter, as in a blending opener, material is extracted from the intermediate chamber and subjected to a further opening step between an inclined spiked lattice (3) and an evener roller (4) (short-term blending). An optical sensor ensures that only a small quantity of fiber stock is held in the mixing chamber in front of the lattice (3). Behind the spiked lattice there is a take-off roller and a simple pneumatic suction feed to the next machine.

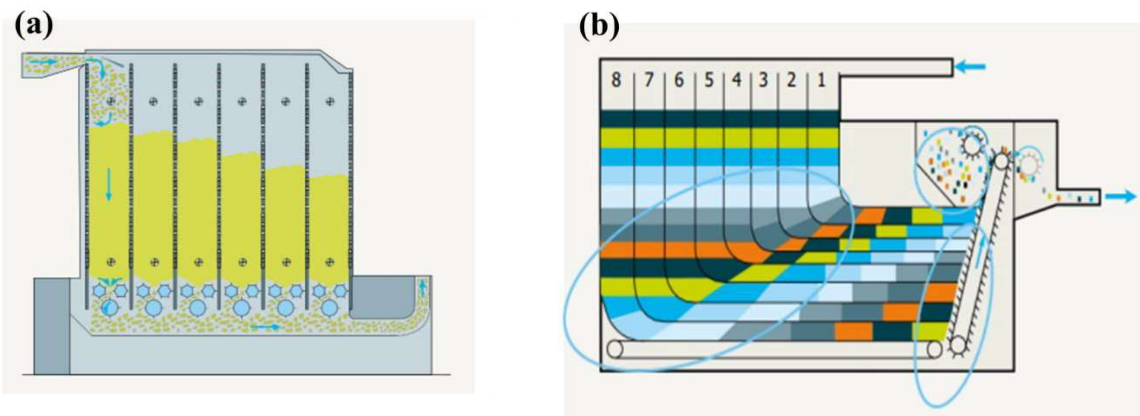


Figure 5 (a) Multimixer, and Unimix

1.5. ZONE-4 (Fine opening and cleaning machines

The zone 4 cleaning machines although utilizes the same principles of opening and cleaning as that of zone 2 cleaning machines but some differences.

1. The zone 4 machine are always fed using clamp feed that is to make sure that controlled amount of fibre size and fibre quantity is fed.
2. The spacing of the beater with the hood of the machine and with the grid is kept finer.
3. Finer and a greater number of striking elements (pins, spikes, etc) are used
4. The speed of the beater is kept higher.

The RN cleaner is one of the most efficient and widely used fine opener and cleaner.

1.6. ZONE-5 (Intense opening and cleaning machine)

In the majority of cases the ZONE 5 machines utilizes the Kirschner beater of the carding roller (roller covered with saw teeth) as the main opening and cleaning devices. A widely used intense opener and cleaner is the ERM cleaner as shown in figure 6.

1.6.1 ERM cleaner

The machine is introduced by m/s Laxmi-Rieter and is very simple in construction. The opening capacity of this machine is very high owing to the use of saw-tooth wires or toothed discs on the beater (A). Different types of beaters are available to permit the quick adaptation for variety of raw materials. This permits greater flexibility in its functioning. The beater section is newly designed and consists of spring loaded feed roller system (B) to ensure uniform and controlled feeding (Fig. 6). The spring loading facilitates sufficient hold on the material issued and at the same time, avoids any excessive nipping. It prevents the snatching and yet enables the feeding of cotton in sufficiently loose form. Thus, a higher degree of opening and cleaning is possible by still maintaining gentle handling of cotton.

The material is received from the previous machine through a chute (C) by using a suitable suction device. It is then separated from the influence of air currents and dropped into a laminar trunk (D). The head of the cotton level in the trunk is controlled electronically. A large glass window in the front of the trunk is provided for the observations. The material at the bottom is guided over the plain drum (E) and perforated dust cage (F) to filter and extract the fine dust from the loose cotton piled-up within the trunk. The air through the cages is finally let out through another vertical chute (M) connected to the cage.

The grid bar section (H) is equipped with an adjustable sheet metal guide interspaced between the knife bars to control the gaps and also to provide for the passage of material. There are in all about 8–10 robust knives with metal sheet guide. The grid is given a fine finishing surface so that the fibres do not adhere to it. The cotton being broken down to very fine tufts is finally taken through the delivery chute (J). Here again, a suction device suitably placed subsequent to the beater helps. The suction air is filtered, whereas the cotton is delivered to the next machine. It is claimed by the manufacturers that the smallest possible size of the tuft that comes through the machine weighs not more than 7–10 mg. For this, however, the state of material fed to this machine has to

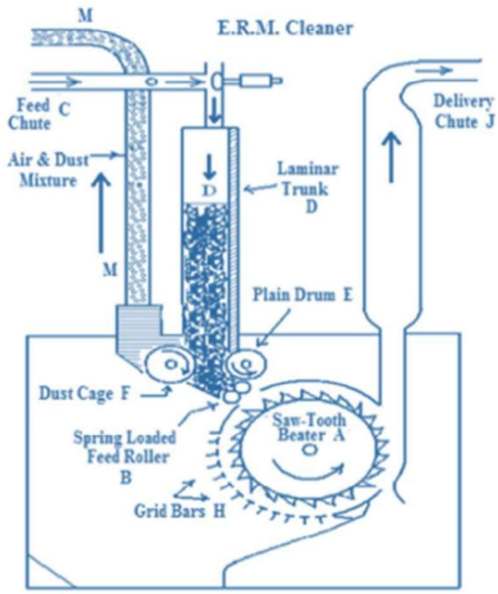


Figure 6. ERM Cleaner

be carefully controlled. The cotton before entering the machine must be in sufficiently loose form, and this necessitates its placement in the later part of blow room sequence. If placed much earlier, not only opening and cleaning get affected but also it endangers the life of saw teeth of the beater. In fact, this is a common criticism levelled against any cleaner equipped with saw teeth. Therefore, the position of such beaters has to be carefully selected so as not to harm the tiny saw teeth. This is because; the tiny saw teeth can very effectively continue their opening action when the cotton fed is in loose form.

The beater with 15¾ inch diameter runs at 1000 r.p.m. The production rates are usually controlled up to 500 kg/hour. An erection platform is provided to allow the beater to be positioned or taken out quickly and easily. The machine has fewer parts, lower power consumption (beater – 5.5 H.P.; feed roller and gearing – 0.25 H.P.; and fan – 4 H.P.), a smaller filter installation unit and requires a moderate space of 38 × 59 (inch) with a height of 13 ft.

1.7. ZONE-6 (Card feed preparation machine)

The feed to the carding machine is possible in two ways, i.e. Chut feed with fibres in opened form and lap feed with the fibres in form of sheet or web. However, whatever the feed method is used, it is essential that the feeding material to the card should be the homogeneous over a long term period.

1.7.1 Chut feed system

Chute feed is a system of feeding small tufts of cotton fibres directly from blow room to a series of cards, arranged in a circuit through pneumatic pipe. A condenser in the pneumatic pipe sucks the material from blow room and delivers it to the flock feeder through pneumatic pipe by way of the filling trunk. Photo electric cell in the filling trunk regulates the supply of material from blow room. From here, the material is fed to the kirschner beater by way of two ridged roller and two feed rollers. Krischner beater open the cotton into desired size tufts.

A fan blows the tufts from the kirschner beater into horizontal c closed circuit loop situated above the cards. The return trunk has the duty of returning the surplus material(after the supply to last card) to the beater that also of uniting well opened material with supply of fresh material thus delivering it directly to the horizontal duct again.

The separating head arranged in the horizontal closed circuit loop divert the part of tufts from air current into vertical feed chutes above the card inlets. Vertical feed chute ensures a uniform supply of material over the full working width of the card. Uniform separation of the tufts from the air current is achieved by adjusting the nose in the separating head. Raising the leading edge produces more separation and vice versa. The weight of the card feed per meter depends on the static excess pressure in the installation. This drops practically linear from separator to separator by about 2mm head of water. The weight of the feed per unit length must be adjusted in accordance with this drop by increasing or deducting the distance between the glass front and the rear wall of the feed chute. The weight per meter ranges between 600 to 700 gms. Thus while deviation of the card sliver count from one card to another must be regulated with the glass plate. The specific count of the sliver itself must be adjusted with the count change wheel. Card Feed Chute: The feed weight at the card depends on the static pressure in the aero feed system and the chute depth adjusted. Since the pressure diminishes from one feed chute to another, the chute depth must be matched accord ingly. It can be varied from 80 mm to 120 mm and is read off on the scale at the arrow mark.

1.7.1.1 Advantages of flock feeding or chute feed system

1. The automatic continuous feed directly linked to the blow room eliminates the lap formation. This increases the working efficiency of the blow room.

2. The main power requirement in doffing the lap, weighing, transportation to card and feeding at the card is eliminated.

3. The processing of rejected laps in the blow room is avoided.

4. The fibres are fed to the ca rd in loose sheet form as against compressed form so that trash particles can be easily extracted from fibres by the carding action.

5. Excessive sliver irregularities due to the lap licking during high humidity, double lap feeding, lap splitting, lap piecing etc, are eliminated.

6.When compared to lap fed, there is a reduction of 1 % CV flock feeding card sliver.

7. Crushing of foreign materials seed bits and other trash particles during calendaring and difficulty of removing a subsequent process is reduced.

1.7.1.2. Disadvantages or limitations of chute feed system:

1. Blow room should run the same number of hours per week as the cards do.
2. The card production must be kept excessive to assure continuous feed to draw frame at the time of stoppages at blow room due to maintenance and other unavoidable problems.
3. The Chute feed system controls short term variation but not the medium- and long-term variations.
4. A reliable check on the nominal count can be established in lap forming system by controlling total lap weight and C.V. value of the weight per unit length. There is no such control in the chute feeding system.
5. Change of mixing will result in more waste in chute feed.

1.8. Principle of feed regulating motion

Regulating motion: Regulating action is responsible for maintaining a constant flow of cotton through each m/c & controlling over the regularity of the material throughout the whole process. The correct amount of cotton in the reserve box may be maintained by using –

1. Swing door.
2. Photoelectric cell.
3. Measuring pressure.

4. Piano feed regulating system.
5. Reserve box.
6. Micro switch

The following devices are used in feed regulation motion. These are used for controlling feed material.

Swing paddle: Swing paddle is used in Bale process.

Swing door: It is used in Hopper feeder & acts as feed regulator.

Paddle lever: It is used in porcupine beater for feed regulating.

Piano feed regulator: It is used in scutcher for feed regulating.

The following regulating action is present in modern B/R.

1.8.1. By photoelectric cell

Here the light source & photocell are fitted opposite a window on each side of the m/c so that the light passes through on to the m/c. While filling the cotton if the light is broken between light source & photocell, the feed of cotton is stopped until cotton again moves away from the light source.

1.8.2. By piano feed regulating system

Object

1. To feed the layer/wave of fiber uniformly to switcher.
2. To control feed by decreasing the speed of feed roller in case of thick places of cotton & by increasing the thin place.
3. To produce uniform lap

Principle:

The pedal movement caused by the thick & thin places of cotton is employed to shift the belt in the cone drums by means of lever to alter the speed of the feed roller in order to keep the feed contains per unit time.

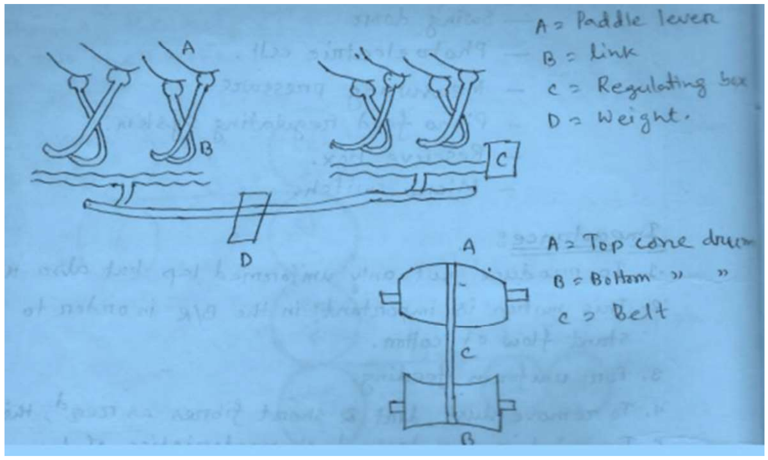


Figure 7. By piano feed regulating system

1.8.3. By air pressure

When air & cotton are fed, air is sucked by another portion, this air pressure is measured by sensor & is used to determine the amount of cotton present in the hoppers. If pressure is more, it stops feeding & if pressure is less, it allows more cotton to enter.

1.8.4. . By swing door:

The arrangement of swing door is such that when the hopper is about $\frac{2}{3}$ and $\frac{3}{4}$ full of cotton, it is forced down against the resistance of the counterbalance spring, then the drive to feed lattice is stopped. The swing door is used for the uniform feeding of cotton to spiked lattice.

1.9. Main features of the modern blow room line

1. High production
2. Reduction of human error
3. A large number of bales can be used for blending.
4. Up to four assortments can be made.
5. Beating by gripping i.e., controlled beating action
6. Smaller tuft size.
7. PLC (Programmable logic controller) system used.
8. Auto stop motion.
9. Less workers required.
10. Less space required.

Flow chart of modern blow room line

Bale plucker

Metal detector

Uniclean

Unimix

Uniflex

Vision shield

Condenser

Chut feed

Carding

EXERCISE

Objective type questions

1. ……….The output of the blow room.

(a) Roving (b) Sliver (c) Lap (d) Yarn

2. Most of the seed particles are removed in

(a) Blow room (b) Combing (c) Weaving (d) knitting

3. Piano feed regulator is used in

(a) Scutcher (b) ERM cleaner

(c) Unimix (d) Multimix

4. ERM cleaner is related to …

(a) Blow room (b) Carding

(c) Simplex (d) Draw frame

5. Feeding of small tuft of fibre directly from blow room to series of cards through pneumatic pipe is called

a. Lab feed system b. mechanical system

c. Chute feed system c. Pipe system

6. Which is not the objective of blow room.

a. Mixing b. opening

c. cleaning d. sliver formation

Very short answer type questions

1. What is the first process/ machine in yarn production?

2. What is blow room?

3. What is pinning.

4. What is the full form of ERM cleaner?

5. What is chute feed system?

6. What is the production of blow room?

7. Why feed regulating motion is required in blow room.

8. What is the function of Unimix in blow room line.

9. What is the function of step cleaner.

Short answer type questions

1. Write the objective of blow room.

2. Write short note on ERM cleaner

3. Write short note on Mono cylinder.

4. Write a short note on principle of opening an cleaning.

5. Write short note on chute feed system in flow room

6. Write short note on feed regulating motion in blow room line.

Long answer type questions

1. Write short note on

   a. ERM cleaner

   b. Unimix

2. Write short note on:

c. Hopper bale breaker

d. Multimix

3. Write short note on:

e. Mono cylinder

f. Step cleaner

2. Explain the principle and function of various feed regulating motion in blow room with neat sketch.

3. Explain the passage of material from hopper bale breaker with neat sktech.

4. Explain the working principle of chut feed system. Write the advantages of chute feed system.

UNIT-IV

Carding

1. Carding

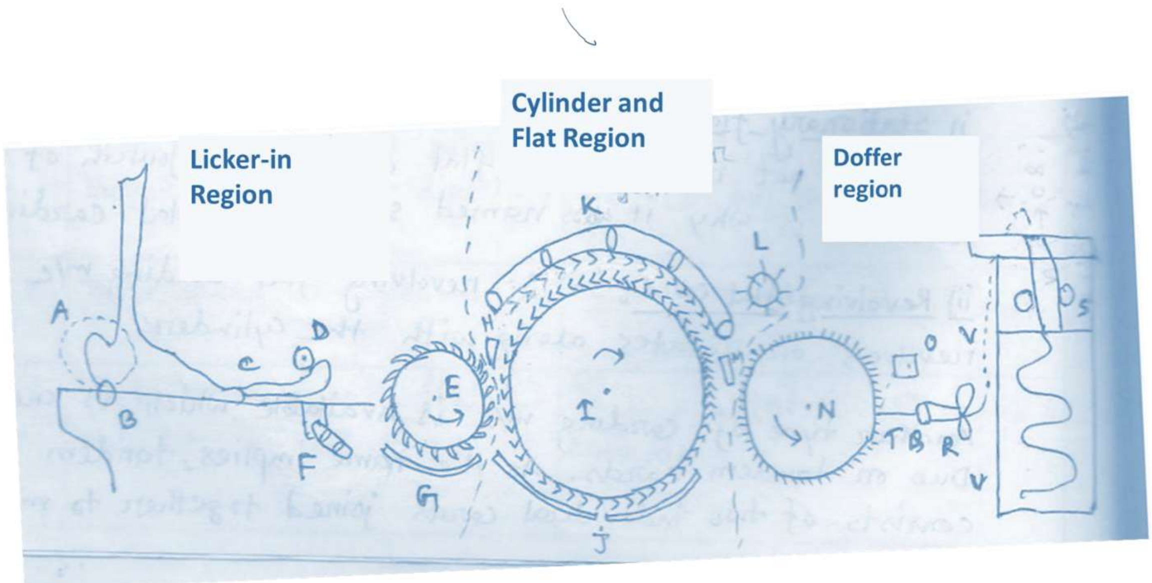
Carding may be defined as the reduction of an entangled mass of fibres to a firmly web by working between two closely spaced, relatively moving surface clothed with sharp wire point.

The carding is the heart of the spinning mill and well carded is half-spun-demonstrated the immense significance of carding for the result of the spinning operation. The importance of carding is still greater where new spinning systems are concerned.

1.1. Objects of carding

2. **Opening to individual fibres:** The blow room only opens the raw material to flocks whereas the card opens it to the stage of individual fibres. This enables the elimination of impurities and good performance of the other operation.
3. **Elimination of impurities and dust:** Elimination of foreign material occurs mainly in the region of the taker in (Licker-in). In addition to free dust which can be directly sucked away as in the blow room, the card also removes a large proportion of the micro particles. The card is good dust removing machine.
4. **Removing of neps:** The card reduces the number of neps from the blow room. Actually, neps are not eliminated at the card, they are mostly opened out. An improvement in disentangling of neps is obtained by; closer spacing between the clothing, sharper clothing; optimal speeds of the licker in; low doffer speeds lower through put.
5. **Elimination of short fibres:** Short fibres can only be eliminated if they are passed into clothing. Elimination of short fibres in the card must be viewed in proportion, actually very small, less than 1% short fibres.
6. **Fibre blending:** The card is the only machine to process individual fibres. In formation of the web and with repeated rotation of the fibres on the main cylinder, intimate fibre with the fibre mixing is achieved.
7. **Fibre orientation:** It is often attributing the effect of parallelizing. The card can be given the task of creating partial longitudinal orientation of fibres.
8. **Sliver formation:** To deposit the fibre material, to transport it and process it further, an appropriate product must be formed.

1.2. Passage of material through revolving flat card



1.2.1. Machine Part

i) Licker-in region

A = Lap,
B = Lap roller
C = Feed plate
D = Feed roller
E = T-in L
F = Mote knives
G = Under casing

ii) Flat & Cylinder region

H = Back plate
I = Cylinder
J = Cylinder-undercasing
K = Flat
L = Flat cleaning brush
M = Front plat

iii) Doffer region

N = Doffer
O = Doffer comb
Q = Template
R = Calendar roller
S = Coiler
T = Web
U = Can
V = Sliver

1.2.2. Working principle

The various parts of carding m/c are shown in fig. The direction of revolving is indicated by the arrow sign. The lap is placed upon a slowly revolving lap roller (B) & The sheet of cotton passes over the smooth surface of the feed plate(C) & on between the curve portion of this plate & feed roller(D). The slow revolution of this roller brings the cotton into the contact with saw teeth of the quickly revolving T-in(E). There are two mote knives(F) under the T-in which remove the dust from the cotton. There are several metal grid bars under the T-in by which the dust & impurities are gathered in T-in under casing(G). The cotton receives a very effective cleaning at this point & the loosened fibres are carried round to the cylinder(I) From T-in. There is flexible or metallic card clothing in the surface of cylinder. The surface speed of cylinder is double to T-in. The flocks themselves are carried along with the main cylinder & carry them forward to the flats(k) which surrounding almost one third of the cylinder & covered also with similar teeth. Their movement is extremely slow & in the same direction as the cylinder. Due to cylinder's high speed & flats smooth speed, there is action of point against point that means carding occurred. As a result, fibres become straight & parallel to each other. After the carding operation has been completed, the carded cotton is now transferred from cylinder to doffer (N). After carding the fibres do not form a transportable intermediate product. Here an additional cylinder (doffer) is required for this purpose. The doffer combines the fibres into a web because of its substantially lower peripheral speed relative to the main cylinder. Here also doffing action is done. The stripping roller draws the web from the doffer. Then it is passed through the template(Q) & calendar roller(R). Here the sliver becomes compressed to some extent, then the coiler (S) deposits it in cans(U). Under the cylinder a cylinder under casing is placed. The working rollers cylinder & flats are provided with clothing which becomes worn during fibre processing & these parts must be reground at regular intervals.

1.2.3. Function and Speed of various part

a. Licker-in

Specification

1. Diameter $\rightarrow 9'' - 9.5''$
2. Speed $\rightarrow$ 600-600 r.p.m.
3. Wire point direction $\rightarrow$ Anticlockwise.
4. Surface speed $\rightarrow$ 1000ft/min.

Object

1. To unwind the lap continuous feed with uncontrolled stretching.
2. To eliminate the impurities.
3. To transfer the fibres as evenly as possible.
4. To perform the primary cleaning & opening of cotton fibre.
5. 50% opening of the entire carding machine is achieved here.

Cleaning in licker-in zone

The extensive opening of fibres at the licker-in allows the removal of impurities with the help of cleaning aids placed beneath the licker-in. The cleaning aid in the conventional card includes

1-2 mote knives and a grid whose half of the surface is performed sheet and the other half is slotted sheet. The impurities are removed as the fibres mass at high speed strikes the knives and the grid. In modern cards to achieve high speeds instead of using grids triangular carding segments are used.

Transfer of fibres to main cylinder

Between the fibre surface of the taker in and the main cylinder the condition of point to back action or stripping action arises. Due to the stripping action, the fibre material is transferred to the main cylinder. As the fibres are transferred to the main cylinder, longitudinal orientational of the fibres takes place here**.**

b. Cylinder

Specification

1. Diameter → 50″(1280mm)
2. Speed → 250-500 r.p.m.
3. Wire point per square inch → 550-650
4. Surface speed → 1000ft/min.
5. Total wire point per cylinder → 30lac.
6. Wire point direction → Anti clock-wise.

Objects

Back plate

1. To hold the fibre.
2. To prevent the development of undesirable air current.

Top feather edge sheet

1. It controls the wt. & thickness of the flat strips.

Cylinder stripping door

1 This door is used to strip the wire point of cylinder.

Bottom sheet

1. To hold the fibre.
2. To prevent the development of undesirable air current.

Cylinder undercasing:

1. Remove dust.
2. To maintain constant airflow.

Removal of trash and short fibres

During the carding action between the flat and the main cylinder the waste gets embedded into the interspacing between the adjacent wires of the flats. The waste includes mainly the short fibres, neps, trash particles and dust. It is therefore very essential to clean off the surface of the flats so that the carding action between the main cylinder and the flats may not be affected. In old carding machines manual cleaning was carried out by stopping the machines after a specific period of time. However, in modern cards the waste removal off the flats is carried out continuedly with the normal operation.

c. Flat

Specification:

1. No. of flats -100-120.
2. Wire point direction -Clockwise
3. Surface speed - 2-7 inch/min.

Objects:

1. To open the flocks to individual fibres.
2. Eliminate of remaining impurities.
3. To eliminate some short fibres.
4. To remove dust.
5. To disentangle Neps.
6. High degree of longitudinal orientation of fibre.

d. Doffer

Specification:

1. Diameter - 27 inch
2. Speed - 30-100 rpm
3. Wire point per square inch -550-650

4. Surface speed - $50\times 27 \times \pi$ inch/min.

Objects:

1. To collect fibre from the cylinder.
2. To strip the fibres from the doffer which is moving slowly by doffer comb in the form of thin web.
3. To condense them into a continuous rope like known as sliver with the help of calender rollers & trumpet.
4. To deposit them in the form of coils in a can with the help of coiler mechanism

Doffing operation

The cylinder is followed by a roller called doffer. The main purpose of the doffer is to take the individual fibres coming from the cylinder and to condense them to a web form. The diameter of the doffer is 24 to 27 inches, and it rotates at a speed of 20 to 60 rpm. The surface speed of the cylinder is about 20 to 25 times more than the surface of the doffer. This help to create thick layer of fibres on the surface of the doffer.

Owing to a very low surface speed of the doffer, the rate of transfer of the fibres is only about 0.2 to 0.3 i.e., on average fibre rotates 3 to 5 times around the cylinder before. It is transferred to the doffer. To improve the transfer rate, the spacing between the cylinder and doffer clothing is reduced clothing is reduced to only 3/1000 inches compared to a standard stripping gauge of 7/1000 inch.

1.3. Card clothing

In carding m/c, different parts (i.e. T-in, Cylinder, Doffer & flats) are covered with different types of wire which are known as card clothing as shown in figure 2. To cover the surface of T-in, Cylinder, doffer & flat of carding m/c with the help of several unlimited fine, closely spaced & specially bunted wire is called card clothing. The wire points are inserted on the m/c surface by means of a base material or foundation. Base material may be of textile fabric or may be of some other material which is very hard & stiff.

Types of clothing: Card clothing is divided into three group.

1. Flexible clothing.

2. Semi-rigid clothing
3. Metallic clothing.

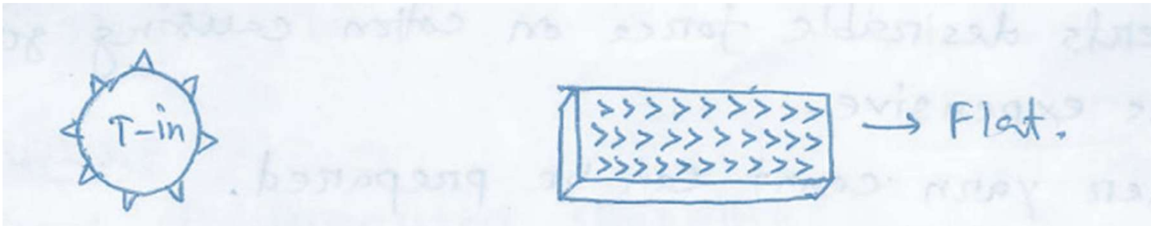


Figure 1. Types of wire used in licker-in and flat

1.3.1. Flexible card clothing

These have hooks of round or oval wire set into elastic, multiply cloth backing. Each hook is bent to a U-shape & is formed with a knee that flexes under bending load & returns to its original position when the load is removed. Flexible clothing is used in cylinder, flats & doffer (Figure 2). In short staple spinning mills this clothing is now found only in the stripping roller.

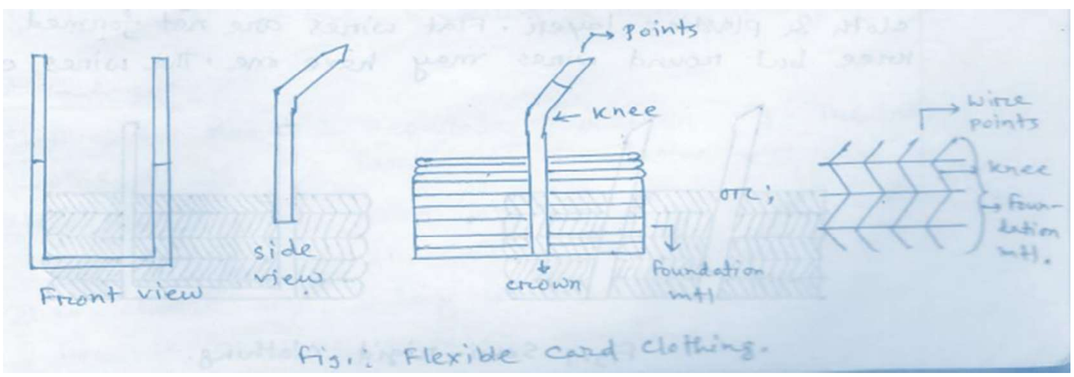


Figure 2. Flexible card clothing

Advantages:

1. Higher point density, so better carding action.
2. Fibre damage is less due to flexible wire point.
3. Only the damaged part of the clothing is needed to be prepared.
4. Exerts desirable force on cotton causing good carding.
5. Less expensive.
6. Finer yarn count can be prepared.

Disadvantages:

1. Requires textile fabric or rubber as foundation material.
2. The wires can be loosened.

3. Production less, due to stripping.
4. Neps regular grinding.
5. Wire & foundation material may get damage because of they are both flexible.
6. Fibre becomes lose for grinding action.
7. Any carding angle cannot be chosen.

1.3.2. Semi rigid clothing

Here flat or round wires with sharp points are set in backing which are less elastic than those of the flexible clothing. These backing are multiple-ply structures, with more plies than the backing of flexible clothing, comprising both cloth & plastics layer. Flat wires are not formed with a knee but round wires may have one (Figure 3). The wires cannot bend & are so deeply set in layers of cloth & possible foamed material that they are practically immovable.

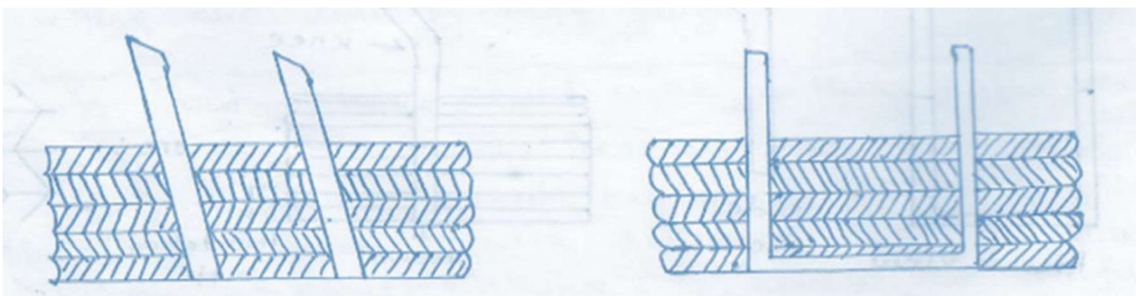


Figure 3. Semi rigid clothing

Advantages:

1. No need of frequent sharping.
2. No need of stripping as well as there is no knee & no dirt & dust is stored.

1.3.3. Metallic clothing

These are continuous, self-supporting flat wire structure in which teeth is cut at the smallest spacing by process resembling a punching operation. They do not need any base mtl or foundation. The wire has no knee. Metal surface of m/c acts as metallic foundation. If the teeth are relatively largely used for example as in the T-in. Then the clothing is referred to as saw tooth clothing. Now-a-days the T-in, main Cylinder & doffer are without exception clothed with metallic clothing. The application of metallic card clothing onto spinning carding m/cs has no limits & is used in the production of low, medium & high-quality yarns.

Advantages

1. Does not require separate foundation material. The metal surface of the m/c works as foundation material.
2. As teeth & foundation material are both metallic, there is no possibility of "teeth loose".
3. Can choose any carding angle.
4. Does not require regular grinding.
5. No change of tooth angle due to carding action & so no need of grinding. Again, fibre do not embed to teeth & so need of stripping. As a result, save much time.
6. Saved 3% good fibre & increase production 18-20% due to no need of stripping & grinding.

Disadvantages

1. Carding action is not better due to less point density.
2. Fibre damage is mere as the wire points are metallic.
3. Difficult to repair in the mill when a portion of it is worn out.
4. If any part of the wire is damaged, then the total clothing is rewind.
5. Expensive.
6. Not suitable to prepare finer count.
7. Liberates more fly pollutes air.
8. Requires higher starting torque.

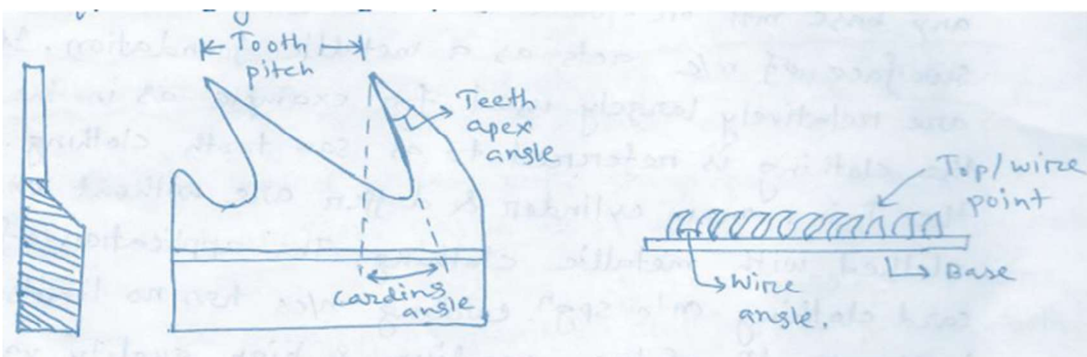
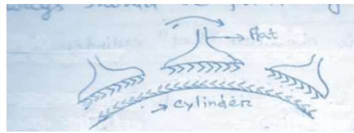


Figure 4. Metallic clothing

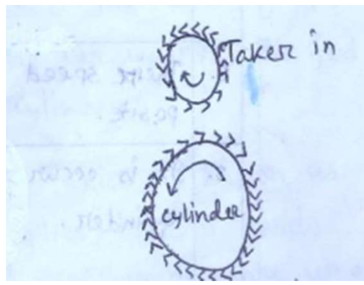
1.4. Difference between carding action and stripping action

Carding action: If two closed surfaces have opposite wire direction & their speed direction or relative motion is also opposite, then the action between two surfaces is known as carding action.



Stripping action:

When two close surfaces have same wire direction & their speed direction or relative motion is also same then the action between two surfaces is called stripping action.



Sr. No.	Carding Action	Stripping Action
1	Two surfaces wire points are inclined in opposite direction.	Two surfaces wire points are inclined in opposite direction.
2	Their speed direction is opposite.	Their speed direction is same.
3	It is occurred between flat & cylinder.	It is occurred between T-in & cylinder.
4	As in this, action, two surfaces are in opposite direction, so minimum amount of fibre stay in lower speedy surface.	As in this, action, two surfaces are in same direction, so maximum amount of fibre stay in lower speedy surface.
5	Fibres are mainly individualized by this action.	Fibres are mainly individualized by this action.
6	Points against point action.	Points against point action.

1.5. Grinding

Grinding is the operation by which the good working condition of the wire points of all organs in the carding m/c is maintained i.e. the process of sharpening the wire points of different organs of carding. As card operates, the wire points of different organs i.e. T-in, cylinder, doffer, flats loss their effectiveness in regular fibre processing & become poor carding unit. The points become dull & their fibre hooking property is weakened. So, the purpose of card grinding is to maintain the wire points of different organs in sharp condition. If grinding is not done, due to the action of cotton & dirt with the wire points become round at the top & loose their aggressiveness. Grinding may be considered in two types of wire.

1. Flexible wire 2. Metallic wire

Objects

1. To increase sharpness of the wire points.

2. To keep equal height of wire.

3. To get regular carding action & uniform sliver.

1.5.1. Types of grinding

a. Traverse wheel (roll) grinding" or "Horse fall grinding":

The transverse grinding consists of a narrow roll or emery wheel of $3\frac{1}{2}$ inch wide 7 inch in diameter which performs grinding process by traversing motion, moving from one end to another end across the wire points of different parts of carding m/c. This emery wheel is mounted on a hollow steel shell of 46″ or 51″ long suitable for 40″ or 45″ wide cards. Within the hollow shell a long central screw shaft is in, which are cut two wide threads, one right hand & one left hand, which join at the two ends. This type of grinding is more commonly used than the long roller type (Figure 5).

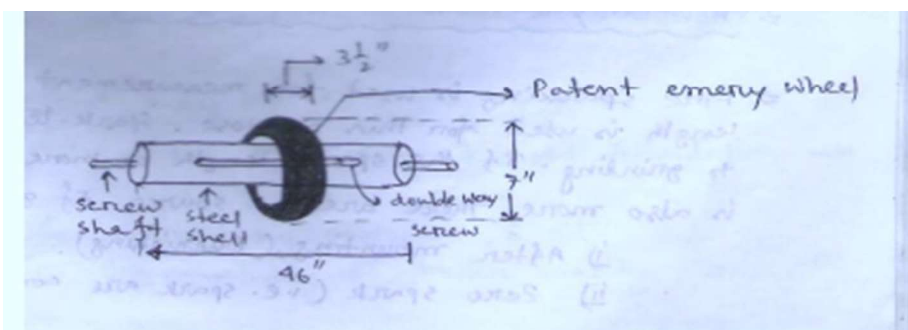


Figure 5. Traverse wheel (roll) grinding" or "Horse fall grinding":

Advantages:

1. Better grinding action.

2. No risk of hooking or fusing of wires.

b. "Long roll grinding" or "dead roll grinding":

The long roll grinder is a sheet shell about 7″in dia & 42″or47″ long suitable for 40″or45″ wide cards. The roller rotates over the full width of the card & performs grinding process. Roller is covered with emery fillet. The roller is carried on a shaft about $1\frac{1}{8}\ inch$ in dia which projects about 12 inches at each end. A traverse mechanism makes this rotating grinding roller traverse backward & forward. Owing to its traverse, the roller impacts a certain amount 'side' grinding to the wire (Figure 6).

Advantages:

1. Long grinding roller is used in case of high-speed grinding.
2. It is used produce low & medium count yarn.

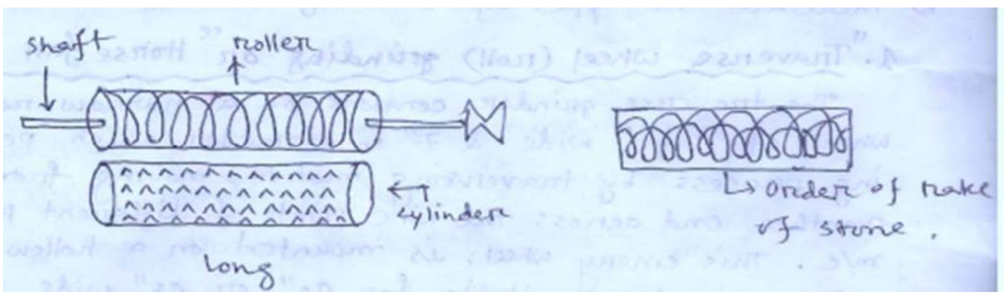


Figure 6. Long roll grinding" or "dead roll grinding

1.6. Auto leveller

Alternative name for autolevelling include autoregulator, draft , leveller. Although these different names are used by different machinery manufacturers, the basic principle remains the same.

1.6.1. Objects of Auto leveller

The object of an autoleveller is to measure the sliver thickness variations & then continuously to after the draft accordingly so that more draft is applied to thick places & less to thin places with the result that the sliver delivered is less irregular than it, otherwise would have been. Besides an improvement in production appearance, autolevelling can also contribute to better productive efficiency, fewer end-breakages in subsequent process, less waste & constant process conditions.

Advantages

1. All variations are corrected.
2. Count c.v.% will be consistent & good, hence the yarn will be suitable for knitting.

3. Thin places in the sliver, hence in the yarn quality will be low.
4. Ring frame breaks will come down, hence pneumofil waste will be low.
5. Fluff in the department will be less, therefore uster cuts will be less.
6. Fabric quality will be good because of lower number of fluff in the yarn.
7. Labour productivity will be more. 8. Machine productivity will be more.
8. Idle spindles will be less. 10. RKM c.v.% will be low, because of low number of thin places.
9. Workability in warping & weaving will be good, because of less no. of thin places & lower end breaks in spinning & winding. 12. Low sliver U%, hence yarn U% will be good.
10. Production will be more accurate in autoleveller draw frame compared to non autoleveller draw frame.
11. Variation in Blend percentage will be very less, if both the components are autolevelled before blending, hence fabric appearance after dyeing will be excellent.

1.6.2. Types of Auto leveller

Auto leveller may classified into two main groups according to the basic principle of operation:

a. Open loop auto leveller

The open loop control principle, which can be used for the correction of fairly short term variations, is represented in figure 7, where the solid lines indicate the flow of fibres through the m/c & the broken lines represent to flow of information in the autoleveller unit. The control unit compares the measurement signal with the reference signal which in this case represents the mean output required. The control unit accordingly increases, leaves unaltered, or decreases the output of the regulatory.

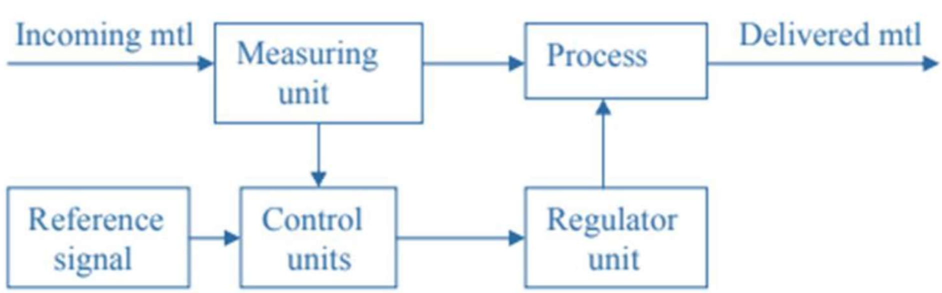


Figure 7. Open loop autoleveller

when the measured material has reached the point at which draft is applied. The magnitude & direction of each change in draft is determined by the magnitude of the change of count previously indicated by the measuring unit. If the direction of the arrows in fig→ (a) is followed from any starting point, it always leads out into the open from the diagram at the place marked material by the control unit. Measurement always takes place on the material prior to the material. Thus, if measurement is made on the input material, the correction may be applied to either the back rollers or the front rollers.

b. Close loop auto leveller

The closed loop principle is illustrated in figure 8; this system is used for the correction of long term & medium-term variations. Again, the measurement signal is compared with the reference signal by the control unit which then determines the output of the regulator which provides the variable speed to the process to give the required draft.

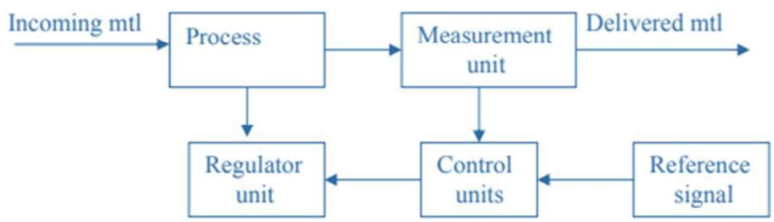


Figure 8. Close loop autoleveller

However, if the direction of the arrows in figure 8, is following from any starting point except the delivery, is always leads to a never-ending circuit of the loop which links the process & the control unit together, hence the name closed loop; measurement always takes place on the mtl after the point where corrective action is applied. Thus, if measurement is made on the output, the correction may be applied to either the back rollers or the front rollers.

It is immediately apparent that the control unit continually cheeks the results of its own actions because measurement is taken from the product of the process. This may be regarded as a basic advantage of the closed loop system, but it is obtained at the price of increased complexity. Because the flow of fibres in the process forms part of the control loop, this means that the amount of control which can be applied is restricted not only by the limitations of the control unit itself, but the characteristics of the process. A closed loop system must be designed so as to avoid hunting, i.e. an unwanted oscillation in the output, in this case sliver thickness.

1.7. Neps and remedies to control neps

1. Ensure that the cylinder speed is high, appropriate to the type of card.
2. Select proper wire points and ensure that they are sharp and in level.

3. Ensure that the flat and cylinder settings are as close as practicable.
4. Keep all surfaces like back plate, front plate, cylinder undercasing, etc., which come in contact with fibres
5. smooth. The smoothness can be achieved by periodic polishing with ‘00’ emery paper, and then applying a paste of French chalk and turpentine, allowing it to dry and the rubbing again with clean, non-oily hard waste.
6. Make hank finer and increase the doffer speed to maintain production rate.
7. Ensure proper gauge between cylinder and doffer.
8. Prevent cylinder loading by ensuring uniform and light feeding.

1.8. Problems, causes and way of remedies for carding defects.

Patchy web

May be due to loading on the cylinder, damaged or pressed wire points, waste accumulation below cylinder under casing or defective undercasing.

The following actions can be taken to solve the problem:

1. Grind the flats and cylinder. In case of major damages replace the wires.
2. Correct the settings between cylinder and flats, cylinder and back plate.
3. Improve feed roller grip.

Singles

May be due to lap licking, less feed in chutes, part of carded web getting sucked by the waste extractor, damaged doffer wire and direct air currents hitting the web.

Sagging web

May be due to insufficient tension draft, very high humidity, worn out key in the calendar roller gears, heavy material fed to card and inadequate calendar roller pressure. Increase tension draft between **doffer** and calendar roller. For excessive sagging reduce doffer speed, maintain RH between 50% and 60%.

High card waste

High card wastes are due to damage under casings, higher flat speed, wider front plate setting, closer setting of flats, and higher pressure in suction unit and fibers getting ruptured.

Higher U% of sliver:

Worn out parts, eccentric movement in coiler calendar or table calendar rollers, uneven feed, waste accumulation in material patch, improper settings and loading of fibers on cylinder and flats are some of the reasons for higher U% of card sliver.

Reasons for higher U% of card sliver:

Check the eccentricity, wobbling, worn-out gears, gears meshing too deep, oblonged bores of gears, loose keys, loose keyways, insufficient tightening of gears of table and coiler calendar rollers and rectify the defects.

Check the condition of trumpet and if it is damaged/oblonged/burred, replace it with a new one. Try bigger diameter of trumpet.

Higher breaks

Very small trumpet, worn out trumpet, uneven sliver with bunches of fibers, worn out gears, damaged clothing, air currents disturbing the web, improper temperature and humidity, very high tension-draft, poor transfer of fibers between cylinder and doffer wires and short of feed from blow room in case of chute feed cards causes higher breakages of web and sliver.

1.9. Latest development in carding machine

1. Higher production rate up to 250 kg/hour
2. Direct feeding system FBK: Chute feed
3. Feed rate control system: CFD (CORRECTA FEED)
4. Multiple licker-in system: 3 Licker-in
5. Precision Flat Setting System PFS
6. Precision Mote Knife Setting System PMS
7. Aluminum flats without bolted connection
8. Computer control with Touch Screen
9. Electronic Flat Measuring System FLATCONTROL TC-NCT
10. ON-line nep counting with NEPCONTROL TCC-NCT
11. Waste quality measuring with WASTECONTROL TC-WCT
12. Digitally controlled, maintenance-free servodrives
13. Integrated Carding Grinding system:
14. IGS Tops

15. IGS Classic
16. Magnetic flat bar: MAGNA TOP
17. Integrated and continuous suction system
18. Larger can size: 1000X1200 mm
19. Roller doffing system

Exercise

Objective type questions.

1. Carding is the _____ of spinning.

a) Heart b) Card c) Textured yarn d) Filament

2***. Cylinder under casing is a part of ….***

a) Comber b) carding c) Simplex d) Draw frame

3***. The output material of the card is….***

a. Yarn b. Lap c. Sliver d. Roving

4. The object of the carding is….

a. Removal of neps b. Disentanglement of neps c. Individualise the neps d. None of the above

5. 50% opening of the entire carding machine is achieved in……….

a Cylinder region b. Licker-in region c. doffing region d. All of the above

6…………exhibits maximum surface speed in carding machine.

a Cylinder b. Licker-in c. Flat d. Doffer

7. Stripping action takes place in between……...

a Cylinder and licker in b. Flat and cylinder

c. doffer and cylinder d. feed roller and licker in

8. Carding action takes place in between……………

a. Cylinder and licker in b. Flat and cylinder

c. doffer and cylinder d. feed roller and licker in

9***. Feed roller diameter in card is***

(a) 80-100 mm (b) 70-80 mm (c) 90-110 mm (d) 70-90 mm

10 ***Diameter of taker-in card is…***

(a) 300 mm (b) 275 mm

(c) 250 mm (d) 225 mm

11. Diameter of the main cylinder in card is

(a) 1300 mm (b) 1200 mm

(c) 1400 mm (d) 1000 mm

12. Fibre rotates how many times on cylinder before transfer to doffer

(a) 3-4 (b) 3-5

(c) 1-2 (d) 2-3

12. Card clothing is classified into how many categories

(a) 2 (b) 4

(c) 3 (d) 1

13. In open loop control system a measuring sensor is provided at

(a) Delivery (b) Feed (c) Middle (d) (A) & (B) both

14. Cylinder is the part of ……

(a) Carding machine (b) Blow room

(c) Draw frame (d) None of the above

Very short answer type of questions

1. Define carding machine.
2. The name of the output product in carding machine.
3. Define stripping action.
4. Define carding action.
5. Which machine is called a heart of spinning?
6. Why use the grinding in carding machine?
7. Why use the auto leveller in carding machine?
8. How many types of card clothing?
9. What is metallic clothing.
10. Define flat.
11. Define cylinder.
12. What are mote knives in carding machine?
13. What is neps?

Short answer type of questions.

1. Write the objectives of carding machine.
2. Write short note on function of auto leveller.
3. Write the difference between carding and stripping action.
4. Why is carding called heart of spinning?
5. What is the objective of licker-in?
6. Write the objective of Cylinder.
7. Write short note on metallic clothing.
8. Write short note on flexible clothing.
9. Write the Advantage of Auto leveller.

10. Write short note on grinding machine.

Long answer type of questions

1. Explain the passage of material from the carding machine with neat sketch.
2. Write the difference between metallic and flexible clothing.
3. Write the working principle of open and close loop auto leveller in carding machine.
4. Write the objective of carding machine.
5. Write the latest development in carding machine.
6. Write short note on:
   a. Licker-in
   b. Cylinder
   c. Flat
   d. Doffer

UNIT V

CALCULATIONS

1. Yarn count

A number which indicates the mass per unit length or length per unit mass of yarn.

- It expresses the fineness of yarn.

There are two system to calculate the yarn count.

a. Direct system
b. Indirect system

1.1. Direct system

Direct system is a method of expressing the mass per unit length of yarn. There are two main direct system used in yarn manufacturing system.

1. Tex
2. Denier

Tex: Weight in grams per 1000 meter or 1 km of yarn.

Denier: Weight in grams per 9000 meter or 9 km of yarn.

Note*: Higher the number (Tex or Denier) coarser the yarn.

1.2. Indirect system

Indirect system is a method of expressing the length per unit mass of yarn. There are three indirect system used in yarn manufacturing system.

English count (Ne): It is the number of hanks of 840 yard per one pound of that yarn.

Metric count (Nm): It is the number of hank of 1000 meter per kg of yarn.

Worsted system (Nw): It is the number of hanks of 560 yards in one pound.

Important-

1 lea=120 yard, 1 hank= 840 yard or 768 meter , Denier=0.354×micronair

2. **Conversion formula for yarn number system**

$Tex = \frac{590.5}{Ne}$, $Denier = \frac{5315}{Ne}$, $Ne = \frac{Nm}{1.693}$

3. **Conversion for weights**

1 pound (lbs)=453.59 gram

1 kg=1000 gram

1 ounce=28.350 gram

1 grains=0.0648 gram

4. **Conversion for linear measurement**

1 yard=0.9144 meter

1 feet= 12 inch

1 meter=100 cm

1 inch=2.54 cm

5. **Cleaning efficiency of blow room**

$$\text{Cleaning efficiency } (\%) = \frac{Trash\ (\%) in\ raw\ fibres - Trash\ (\%) in\ processed\ fibres}{Trash\ (\%)\ in\ raw\ fibres} \times 100$$

Another very practical equation to find the cleaning efficiency is:

$$\text{Cleaning efficiency } (\%) = \frac{Waste\ (\%)\ removed - Trash\ (\%)\ in\ waste}{Trash\ (\%)\ in\ raw\ fibres} \times 100$$

$$\text{Cleaning efficiency } (\%) = \frac{Trash\ (\%)\ reamins\ after\ processing}{Total\ trash\ (\%)} \times 100$$

Q. A lap contains 2% trash after processed in B/R having the cleaning efficiency of 80%. Find the trash (%) in raw cotton.

Ans. We know,

$$\text{Cleaning efficiency } (\%) = \frac{Trash\ (\%)\ reamins\ after\ processing}{Total\ trash\ (\%)} \times 100$$

$$80 = \frac{2}{Total\ trash\ (\%)} \times 100$$

Total trash (%) =**2.5 % (Ans.)**

6. Cleaning efficiency of Carding

The ratio of trash removed in carding and trash in lap expressed as a percentage, which is called cleaning efficiency of carding. Cleaning efficiency of carding is 70-85%.

$$\text{Cleaning efficiency of card (\%)} = \frac{Trash\ (\%) in\ lap - Trash(\%)\ in\ sliver}{Trash\ in\ lap} \times 100$$

$$\text{Cleaning efficiency of card (\%)} = \frac{Trash\ removed}{Trash\ in\ lap} \times 100$$

7. Material (Yarn) Realization

It is the term used to denote the percentage of yarn produced from given weight of raw cotton. It depends on waste extraction.

$$Yarn\ realization\ (\%) = (92 - Z)\ for\ carded\ yarn$$

$$= (95 - Z)\left(1 - \frac{C}{100}\right) - 3, for\ combed\ yarn$$

$$Where, \qquad Z - Trash\ extracted\ (\%) in\ process\ stage, C - Comber\ noil\ (\%)$$

8. Calculation of draft

Draft in blow room: As the material passes through the nip of the rollers with step-up speeds, it gets pulled or attenuated. This motion of drawing or pulling of the stock continues throughout the spinning process. In some cases, there is purposeful attempt made to attenuate the material; while in some others, a very slight pulling action is exercised. At most of the places in the blow room, the latter action is followed, whereas the former action is used in many subsequent processes till the final yarn is formed. In this article I will discuss about draft calculation of blow room with examples. We can express draft is as follows.

$$Draft = \frac{Draft\ constant}{Change\ wheen\ teeth}$$

$Draft = \frac{Tex\ (feed)}{Tex\ (Delivery)}$, (When count used in direct system)

$$Draft = \frac{Ne\ (Deliver)}{Ne\ (Feed)}\ , \qquad When\ count\ used\ in\ indirect\ system$$

$$Total\ draft\ in\ card = \frac{Feed\ weight\ in\ g/m}{Sliver\ weight\ in\ g/m}\ ,$$

There are three types of drafts in blow room:

1. Mechanical Draft (M.D.)
2. Actual or Resultant Draft (A.D./R.D.) and
3. Tension Draft

8.1 Mechanical draft

The relative speed difference in the rate of feeding and rate of delivery results in mechanical drafting action. It is governed by the mechanical gears or pulleys.

$$Mechanical\ Draft = \frac{Delivery\ roller\ surface\ speed}{Feed\ roller\ surface\ speed}$$

8.2. Actual draft

$$Actual\ draft = \frac{Ne\ (Deliver)}{Ne\ (Feed)}\ ,$$

The relation between the actual draft and mechanical draft is given as follows

$$Actual\ draft = \frac{Mechanical\ draft}{100 - waste\ (\%)} \times 100$$

8.3. Tension Draft:

At many places in spinning, only a slight stretching action is required to be ex-ercised on the material rather than the regular thinning out operation. Such tensioning is necessary to avoid sagging or wrinkling of the material in the process. This con-trolled stretching is called Tension Draft.

9. **Production in blow room and carding**
    a. Production in kgs/hr (if count in Ne) :

    P=(L×1.0936×60×efficiency)/hank (Ne)×36×840×2.2045)

    b. *Production in kgs/hr (if count in Ktex)*
    P=(L×Ktex×60×efficiency)/1000

Where, P- Production kgs/hf, L-delivery speed in meter/min