

CARDING (textile) Process parameters

INTRODUCTION:

Carding is the most important process in spinning. It contributes a lot to the yarn quality. The following process parameters and specifications are to be selected properly to produce a good quality yarn with a lower manufacturing cost.

cylinder wire(wire angle, height, thickness and population) flat tops specification licker-in wire specification doffer wire specification feed weight draft between feed roller and doffer cylinder grinding doffer grinding flat tops grinding cylinder, flat tops, doffer wire life Licker-in wire life Cylinder speed flat speed Licker-in speed setting between cylinder and flat tops setting between licker-in and feed plate setting between lickerin and under casing elements like, mote knife, combing segment etc. setting between cylinder and doffer setting between cylinder and back stationary flats setting between cylinder and front stationary flats setting between cylinder and cylinder under casing

CYLINDER WIRE AND CYLINDER SPEED

Cylinder wire selection is very important, it depends upon cylinder speed, the raw material to be processed and the production rate. The following characteristics of cylinder wire should be considered.

1. wire angle
2. tooth depth
3. wire population
4. rib thickness
5. tooth profile
6. tooth pitch
7. tooth point
8. overall wire height

Wire front angle depends on mainly cylinder speed and coefficient of friction of raw material.

Higher the cylinder speed, lower the angle for a given fibre. The cylinder speed in turn depends upon the production rate.

Higher production means more working space for the fibre is required. It is the wire that keeps the fibre under its influence during carding operation. Therefore the space within the wire should also be more for higher production.

Higher cylinder speed also increases the space for the fibre. Therefore higher cylinder speed is required for higher production.

In the case of high production carding machines, the cylinder surface is very much higher, therefore even with higher number of fibres fed to the cylinder, the cylinder is renewing the carding surface at a faster rate.

Higher the cylinder speed, higher the centrifugal force created by the cylinder, this tries to eject the fibre from the cylinder, along with the trash. It is the cylinder wire's front angle which overcomes the effect of this force. Low front angle with too low cylinder speed and with high frictional force will result in bad quality, because the fibre transfers from cylinder to doffer will be less. Hence recycling of fibres will take place, which result in more neps and entanglements.

The new profile with less free blade avoids loading of the cylinder with fibre and/or trash.

This helps in keeping the fibres at the tip of the tooth. The movement of the fibres towards the tip of the tooth coupled with centrifugal action demands an acute front angle to hold the fibre in place during carding. Lack of stiffness associated with fine and/or long fibres necessitates more control during the carding process. This control is obtained by selecting the tooth pitch, which gives the correct ratio of the number of teeth to the fibre length. Tooth pitch reduction is therefore required for exceptionally short fibres and those lack stiffness.

Number of points across the carding machine is decided by the rib width. It is selected based on the production rate and fibre dimensions. Finer the fibre, finer the rib width. The trend is to finer rib width for higher production.

The population of a wire is the product of the rib thickness and tooth pitch. The general rule is higher populations for higher production rates, but it depends upon the application.

Sharp tooth points penetrate the fibre more easily and help to intensify the carding action. Cut-to-point wires are sharp and they have no land at all.

The effective working depth of a cylinder wire tooth for cotton is approximately 0.2mm and for synthetic materials approx.0.4mm. Manmade fibres require more space in their cylinder wire than doe's cotton. More tooth depth allows the fibre to recycled, resulting in damaged fibres and neps. If tooth depth is insufficient, there will be loss of fibre control. This will result in even greater nep generation. Looking into the above details, the following specifications can be used as a guideline

MATERIAL	PRODN. RATE	RIB WIDTH	ANGLE(degrees)	POPULATION
Cotton low grade	low	0.6	65	700
Cotton low grade	high	0.5	55	840
Cotton Medium	low	0.6	60	800
Cotton Medium	high	0.4 to 0.5	55	840 to 950
Cotton fine	low	0.5	60	840
Cotton long	high	0.4 to 0.5	55	900 to 1100
Synth.coarse	low	0.7 to 0.5	70	550 to 650
synth.coarse	high	0.6	65	760
Synth.medium	low	0.7	65	700
synth.medium	high	0.5	65	760
Synth.fine	low	0.6	65	700
synth.fine	high	0.5	60	840

MATERIAL	PRODCUTION RATE	CYLINDER SPEED
cotton	low	360 to 400
cotton	medium	430 to 470
cotton	high	500 to 550
synthetic	low	300
synthetic	medium	380
synthetic	high	460

DOFFER, LICKER-IN AND FLAT TOPS:

- The basic function of doffer is to strip the fibres from Cylinder. Please remember that the action between cylinder and doffer is carding action (or combing action or point to point action).
- The doffer wire's front angle plays a very important role in releasing the fibre from the cylinder. For most carding applications the optimum angle is 60 degrees.
- Increased population over 400 ppsi does not give any advantage in the production of quality yarn. For smaller doffers, 5 mm doffer wire height helps in transferring the fibres from cylinder to doffer.
- If the fibre holding capacity of the doffer wire is less due to fibre friction or due to very high doffer speed, it is better to use a doffer wire with striations. For high production carding it is always better to use doffer wire with striations.
- Licker-in plays a major role in opening the fibre tufts. In general 85 degrees is used both for synthetic and medium and long cottons. For coarse and dirty cottons 80 degrees can be used.
- Strength, hardness and sharpness are very important for Lickerin wire. Licker-in wires should never be ground. Thinner blades penetrate the fibres more efficiently and increase the wire life.
- Higher number of rows per inch gives better results. Now up to 12 rows per inch is being used. This is always better compared to 8 rows per inch.
- If the wire pitch is not sufficient, it can be compensated by increasing the licker-in speed. Higher licker-in speeds for fine and long cottons will rupture the fibres. Licker-in speed depends upon the fibre type and the production rate.
- It is better to use a flat top with more than one population. The general combination is 280/450. This is suitable for both cotton and synthetics. Please remember that the rigidity of the fillets is different for cotton and synthetic. If cotton flat tops are used for synthetic processing, the load on the cylinder will be more, more heat will be produced and hence the probability of cylinder loading due to electrostatic charge will be high.
- Instead of using Rigid type flat tops, it is better to use semirigid type flat tops while processing synthetic fibres.

SETTINGS:

- The setting between cylinder and doffer is the closest setting in the card. This setting mainly depends upon the cylinder speed, hank of the delivered sliver and the type of wire. Cylinder speed up to 360, the setting should be 0.1mm. For cylinder speeds more than 450, the setting ranges from 0.125 to 0.15.
- If the setting between cylinder and doffer is very close, the wires will get polished and this will affect the fibre

transfer. If the setting is too wide, the fibres will not be transferred to doffer from the cylinder, hence cylinder will get loaded. While processing synthetic fibres cylinder loading will badly affect the yarn quality. Moreover, it is difficult to improve the wire condition if the loading is severe. The only solution would be to change the wire. Therefore enough care should be taken while processing synthetic fibres.

- The most critical setting in a carding machine is between cylinder and flat tops. While processing cotton, it can be as close as 0.175 mm provided the mechanical accuracy of flat tops is good. Since most of the cards are with stationary flats at the licker-in side, the setting from the back to front for flats can be 0.25, 0.2, 0.2, 0.2, 0.2mm.

- Closer the setting between cylinder and flats, better the yarn quality. Neps are directly affected by this setting. Of course, very close setting increase the flat waste. For processing cotton the setting can be 0.25, 0.2, 0.2, 0.2, 0.2mm. For synthetic fibres it can be 0.3, 0.25, 0.25, 0.25, 0.25mm

- Most of the cards are with 6 to 11 stationary flats at the licker-in side. This setting can start with 0.4 mm and end with 0.25mm.

- The wire points can start with 140 ppsi and end with 320 ppsi. The work done by the first few stationary flats is very high; therefore the wear of these flats is also high. It would be better if the first 50% of the flats are changed after 100000 kgs of production and the rest after 150000 kgs of production.

- These stationary flats open the material so that, the setting between cylinder and flats can be as close as possible.

- The setting between feed plate and Licker-in depends upon the type of feed plate. Conventional feed plate setting is decided mainly by the feed weight and to some extent by the fibre length and type. With the latest feed plate and feed roller arrangements, the setting is decided mainly by the fibre length and to some extent by the feed weight.

- Normally the setting between the feed plate and Licker-in is around 0.45 to 0.7mm, depending upon the feed weight and fibre type.

- The setting between Licker-in and the first mote knife is around 0.35 to 0.5 mm. This helps to remove the heavier trash particles and dust. Closer the setting, higher the wastage. The setting between Licker-in and combing segments is around 0.45 to 0.6. This helps to open the material.

- Some cards have two mote knives in the Licker-in under casing. The setting is around 0.4 to 0.5mm. This helps to remove the smaller trash and dust particles.

- The setting between the cylinder and stationary flats at Doffer side helps to transfer the fibres to doffer by stripping the fibres to the top of the cylinder wire. This setting can be as close as 0.15mm. The number of wire points on stationary flats also plays a major role. It is normally around 300 to 400. For a high production application it can be as high as 600.

- For cotton processing, the stationary flats are fixed with a knife attachment. The setting should be as close as possible, i.e. around 0.15mm. This helps to remove the trash particles of very small size.

- The setting between cylinder and cylinder under casing should be as per the manufacturer's recommendation. The design of under casing is different for different manufacturers. This setting is very important, as wrong settings will affect the fibre transfer and can also create air turbulence.

SPEEDS:

- Higher cylinder speed helps fibre transfer. Higher the production, higher should be the cylinder speed.

- Higher cylinder speed improves carding action, thereby imperfections are reduced.

- Higher Licker-in speed for coarse fibres and dirty cotton helps to remove the trash and improves, br> the yarn quality. For fine and long cottons, higher speed results in fibre rupture, therefore, flat waste and comber noil will be more.

- Higher flat speed, improves yarn quality and at the same time increases the flat waste

- With the same flat speed, higher the carding production, lower the flat waste and vice-versa.

- Very high tension drafts will affect carding U%. It is better to keep the draft between feed rollers to doffer around 75 to 95. The results are found better with these drafts.

WIRE MAINTENANCE:

- For a modern cylinder wire of 2mm height, grinding with the normal grinding stone is not recommended. It is better to use TSG grinder to grind the wire every 2nd or 3rd month, so that the sharpness of the wire is always maintained.

- TSG grinder does not grind the wire, therefore if the wire is worn out very badly the quality improvement using this grinding machine will be nil. Frequent grindings are recommended. If TSG grinder is not available, it is better not to grind 2mm wires.

- The number of traverse should increase depending upon the life of the wire. The number of traverse for successive grindings should be like this 3, 5, 10, 17 etc. Anyway the best method is to confirm with the microscope. If the grinding is not sufficient, the number of traverse should be increased.

- Doffer is still working with a concept of Land formation. A normal grinding machine will be good for doffer grinding.

All the wire points should be touched by the grinding stone. A slow and gradual grinding with the grind-out concept will give the best results. Harsh grindings will result in burr formation on the land. This will increase the number of hooks in the fibre; thereby the effective length of the fibre from this card will be reduced.

- Flat tops grinding is very important. Every time a flat top is ground, yarn quality is improved. It is better to use a

grinding machine with the emery fillet. Frequent flat tops grinding will result in less neps and the yarn quality will be consistent.

- Some mills increase the life of the flat tops compared to cylinder wire. But it is better to change flat tops and cylinder wire together for better and consistent yarn quality.
- It is a good practice to check the individual card quality before changing the wire.
- Licker-in wire should be changed for every 150000 kgs. Earlier changes will further improve the yarn quality.
- Stationary flats should be changed for every 150000 kgs. But it is a good practice to change the first 3 or 6 stationary flats at Licker-in side for every 100000 kgs. This helps to maximize the carding effect between cylinder and doffer which is critical for better yarn quality.

OTHERS:

- Lower the feed variation, better the carding quality. Even if the card is with an auto leveler, feed variations should be kept as low as possible (plus or minus 10%). With the latest chute feed systems, it is easy to control the feed variation with in 5%. Lower the feed variation, lower the draft deviation, therefore yarn quality will be consistent.
- If the card is with auto-leveller, the nominal draft should be selected properly. Improper selection will affect sliver C.V% and yarn quality.
- Improper feed roller loading and the setting between feed roller and feed plate will affect the quality, especially C.V% and neps.
- Before mounting, the eccentricity of cylinder and doffer should be checked. Eccentric cylinder and doffer will affect the U% and will affect C.V. % also.
- Defective bearings, gears and timing belts will affect U%.
- Uneven distribution of tension drafts will affect U%.
- Selvage of feeding bat should be good. It should not be folded and double. This will increase the neps and sometimes it may result in cylinder loading. Lap fed to the carding machine should be narrower than the nominal width of the machine.
- For processing cotton, minimum 800 Pascal suction pressures should be maintained at trash master (at knife) for effective removal of trash and dust particles.
- Worn or damaged scraper blades will lead to web sticking to crush rollers. Insufficient pressure between scraper blade and crush roller will also result in web sticking. If the calendar roller pressure is too high web sticking will also be high.
- If Cylinder under casing nose at doffer side is too long for the type of fibre being carded web disappearing problem will arise. If the nose is set too close to the cylinder, web disappearing problem will arise. Damaged and dull doffer wire also will result in web disappearing problem.