METALLIC CARD CLOTHING

INTRODUCTION:
As Carding machine design improved in 1950's and 60's, it became apparent that card clothing was a limiting factor
Much time and effort was spent in the development of metallic card clothing.

- There are two rules of carding
  1. The fibre must enter the carding machine, be efficiently carded and taken from it in as little time as possible
  2. The fibre must be under control from entry to exit
     - Control of fibres in a carding machine is the responsibilitgy of the card clothing
     - Following are the five types of clothings used in a Carding machine
       1. Cylinder wire
       2. Doffer wire
       3. Flat tops
       4. Licker-in wire
       5. Stationary flats

       CYLINDER WIRE:
       The main parameters of CYLINDER Card clothing

       6. Tooth depth
       7. Carding angle
       8. Rib width
       9. Wire height
       10. Tooth pitch
       11. Tooth point dimensions
     - TOOTH DEPTH:
       1. Shallowness of tooth depth reduces fibre loading and holds the fibre on the cylinder in the ideal position
          under the carding action of the tops. The space a fibre needs within the cylinder wire depends upon
          its Micronaire/denier value and staple length. ould have to be reduced.
       2. The recent cylinder wires have a profile called "NO SPACE FOR LOADING PROFILE"(NSL). With this
          new profile, the tooth depth is shallower than the standard one and the overall wire height is reudced
          to 2mm , which eliminates the free blade in the wire. This free blade is responsible for fibre loading.
          Once the fibre lodges betweent the free blade of two adjacent teeth it is difficult to remove it.Inorder
          to eliminate the free blade, the wire is made with a larger rib width
     - FRONT ANGLE:

       1. Front angle not only affects the carding action but controls the lift of the fibre under the action
          of centrifugal force. The higher the cylinder speed , the lower the angle for a given fibre. Different fibresM
          have different co-efficients of friction values which also determine the front angle of the wire.
       2. If the front angle is more, then it is insufficient to overcome the centrifugal lift of the fibre
          created by cylinder speed. Therefore the fibre control is lost, this will result in increasing flat waste
          and more neps in the sliver.
       3. If the front angle is less, then it will hold the fibres and create excessive recyling within the carding
          machine with resulting overcarding and therefore increased fibre damage and nep generation.
       4. Lack of parallelisation, fibre damage, nep generation, more flat waste etc. etc., are all consequences
          of the wrong choice of front angle.
     - TOOTH PITCH:
       1. Each fibre has a linear density determined by its diameter to length ratio. Fine fibres and long fibres

necessitates more control during the carding process. This control is obtained by selecting the tooth pitch which gives the correct contact ratio of the number of teeth to fibre length.

2. Exceptionally short fibres too require more control, in this case , it is not because of the stiffness but
because it is more difficult to parallelise the fibres with an open tooth pitch giving a low contact ratio.

- RIB THICKNESS:

1. The rib thickness of the cylinder wire controls the carding "front" and thus the carding power. Generally the finer the fibre, the finer the rib width. The number of points across the carding machine is
determined by the carding machine's design, production rate and the fibre dimensions. General trend is towards
finer rib thicknesses, especially for high and very low production machines.
2. Rib thickness should be selected properly, if there are too many wire points across the machine for a
given cylinder speed, production rate and fibre fineness, "BLOCKAGE" takes place with disastrous results
from the point of view of carding quality. In such cases, either the cylinder speed has to be increased or
most likely the production rate has to be reduced to improve the sliver quality

- POINT POPULATION:
The population of a wire is the product of the rib thickness and tooth pitch per unit area. The general rule higher populations for higher production rates, but it is not true always. It depends upon other factors like production rate, fineness, frictional properties etc.
- TOOTH POINT:
The tooth point is important from a fibre penetration point of view. It also affects the maintenance and consistency of performance. Most of the recent cylinder wires have the smallest land or cut-to-point. Sharp points penetrate the fibre more easily and thus reduce friction, which in turn reduces wear on the wire and extends wire life.
- BLADE THICKNESS:
Blade thickness affects the fibre penetration. The blade thickness is limited by practical considerations,but the finer the blade the better the penetration of fibres. Wires with thin blade thickness penetrate the more easily and thus reduce friction, which in turn reduces wear on the wire and extends wire life.
- BACK ANGLE:
A lower back angle reduces fibre loading, but a higher value of back angle assists fibre penetration. Between the two extremes is an angle which facilitates both the reduction in loading and assists fibre penetration and
at the same time gives the tooth sufficient strength to do the job for which it was designed.
- HARDNESS OF WIRE:
The cylinder wire needs to be hard at the tip of the tooth where the carding action takes place.The hardnessis graded from the hard tip to the soft rib. High carbon alloy steel is used to manufacture a cylinder wire and it is flame hardened. Rib should not be hardened, otherwise, it will lead to mounting problems.
- The design or type of clothing, selected for the fibre to be carded is important, but it is fair to state that within reason, an incorrect design of clothing in perfect condition can give acceptable carding quality whereas a correct clothing design in poor condition will never give acceptable carding quality. There is no doubt that the condition of the clothings is the most important single factor affecting quality at high rates of production. Wire condition and selection of wire are considered to be the two most important factors which influence the performance of modern high production carding machines.
- The condition of the clothing may be defined as the collective ability of the individual teeth of the clothing to hold on to the fibre against the opposing carding force exerted by other teeth acting in the carding direction. For a given design of clothing the condition of the teeth determines the maximum acceptable production rate that can be achieved at the card.
- The speed of the main cylinder of card provides the dynamic force required to work on separating the fibres fed to the card but it is the ability of the carding teeth on the cylinder to carry the fibre forward against the opposing force offered by the teeth of the tops which determines the performance of the card. Increasing cylinder speed increases the dynamic forces acting upon the carding teeth and thus the condition of teeth becomes more important with increased speed.If the condition and design of the cylinder wire is poor, the teeth will not be able to hold onto the fibre through the carding zone, thus

allowing some of the freed fibre to roll itself into nep.

DOFFER WIRE:

1. The doffer is a collector and it needs to have a sharp tooth to pickup the condensed mass of fibres circulating on the cylinder. It also requires sufficient space between the teeth to be efficient in fibre transfer from the cylinder, consistent in the transfer rate and capable of holding the fibre under control until the doffer's stripping motion takes control.
2. A standard doffer wire has an overall height of approx. 4.0 mm to facilitate the deeper tooth which must have sufficient capacity to collect all the fibre being transferred from the cylinder to meet production requirements. Heavier webs require a deeper doffer tooth with additional collecting capacity to hanndle the increased fibre mass.
3. The doffer wire's front angle plays a very important part in releasing the fibre from the cylinder wire's influence. A smaller angle has a better chance of enabling the doffer wire's teeth to find their way under the fibres and to secure the fibre's release from the cylinder with greater efficiency.
   A 60 degree front angle for Doffer has been found to give the optimum performance under normal carding conditions. Too small an angle results in cloudy web and uneven sliver whilst too large an angle results in fibre recirculation and nep generation.
4. Having collected the fibre, it is important for the doffer to retain it until it is stripped in a controlled manner by the doffer stripping motion. The tooth depth, tooth pitch and rib width combine to create the space available for fibre retention within the doffer wire. Thus they directly influence the collecting capacity.
   If the space is insufficient, fibre will fill the space and any surplus fibre will be rejected. When the surplus fibre is left to recirculate on the cylinder, cylinder loading can take place. Unacceptable nep levels and fibre damage will also result. In severe cases pilling of the fibre will take place.
5. The point of the doffer wire normally has a small land which helps to strengthn the tooth. The extremely small land of around 0.05 mm ensures that the doffer wire height is consistent, has no adverse effect on fibre penetration and is considred essential for efficient fibre transfer from the cylinder. The land has micropscopic striations which are created during manufacturing or grinding. The striations help to collect the fibres from the cylinder and keep them under control during the doffing process.
6. It has been found that a cut-to-point doffer wire penetrates the fibre better than does the landed point wire but is less likely to keep the fibre under control during the doffing process. Sometimes a cut-to-point doffer wire is accompanied by striations along one side of the tooth for this reason.
   Until recently 0.9mm rib thickness is standardised for doffer wire, regardless of production and fibre characteristics.This rib thickness has been found to give optimum results. However doffer wires with a 0.8mm rib thickness have been introduced for applications involving finer fibres.
7. In general 300 to 400 PPSI(points per square inch) has been found to perform extremely well under most conditions. Doffer wire point population is limited by the wire angle and tooth geometry. Higher population for doffer does not help in improving the fibre transfer.
8. As the production rate rises, the doffer speed also increases. The doffer is also influenced by the centrifugal force, as is the cylinder.But cylinder wire front angle can become closer to counter the effect

of centrifugal force, to close the front angle on a doffer wire would reduce its collecting capacity and result in a lowering of the production rate. The solution is to use the wire with striations, which will hold the fibre until the doffer is stripped.

9. The hardness of the doffer wire is a degree lower than that of the cylinder but sufficiently hard to withstand the forces generated in doffing and the resultant wear of the wire. The reason for this slightly lower hardness requirement is the longer and slimmer tooth form of the differ wire.
10. The fibres which are not able to enter the wire will lay on top, i.e.completely out of control. There fore instead of being carded by the tops the fibres will be rolled. Similarly a fibre buried too deep within the cylinder wire will load the cylinder with fibre, weaken the carding action and limit the quantity of new fibres the cylinder can accept. Therefore, the production rate would have to be reduced.

LICKER-IN WIRE:

- Licker-in with its comparatively small surface area and small number of carding teeth, suffers the hardest wear of all in opening the tangled mass of material fed to it.
- Successful action of the Licker-in depends upon a penetrating sharp point rather than a sharp leading edge as with the cylinder wire. Therefore the licker-in wire cannot be successfully restored to optimum performance by grinding.
- The most satisfactory system to adopt to ensure consistent performance is to replace the licker-in wire at regular intervals before sufficient wear has taken place to affect carding quality.
- The angles most widely used are 5 degrees negative or 10 degrees.
- There is no evidence to suggest recommendation of a tooth pitch outside the range of 3 to 6 points per inch.
- It is better to use Licker-in roller without groove. Interlocking wires are used for such type of licker-ins. This avoids producing the eight precise grooves and to maintain them throughout its life. Interlocking wire is almost unbreakable and thus no threat to the cylinder, tops and doffer in the event of foreigh bodies entering the machine.
  FLAT TOPS:

  1. The flat tops are an equal and opposite carding force to the cylinder wire and it should be sharp, well maintained and of the correct design.
  2. The selection of flexible tops is very much related to the choice of cylinder wire, which in turn is related to the cylinder speed, production rate and fibre charactersitics, as previously stated.
  3. The modern top is of the semi-rigid type, having flexible foundation and sectoral wire. The points are well backed-off and side-ground to give the necessary degree of fineness. The strength of the top from a carding point of view is in the foundation and is affected by the number of plies and the type of material used.
     The position of the bend in the wire is determined by stress factors, at around 2:1 ratio along the length of the wire protrusion.
  4. The modern top is made from hardened and tempered wire to increase wear resistance , thus improving the life of the flat top.
- Life of the cylinder wire depends upon
  1. Material being processed
  2. production rate
  3. cylinder speed
  4. settings
- Wear is the natural and unavoidable side effect of the work done by the vital leading edge of the metallic wire tooth in coping with the opposing forces needed to obtain the carding action which separates fibre from fibre.
  When the leading edge becomes rounded due to wear, there is a loss of carding power because the point

condition
has deteriorated to an extent where the leading edge can no longer hold on to the fibre against the carding
resistance of the flats. This ultimately leads to fibres becoming rolled into nep with consequent degradation
of carding quality.
Therefore it is important to recognise that, due to the inevitable wear which takes place
during carding, metallic wire must be reground at regular intervals with the object of correctly resharpening
the leading edge of each tooth.

- **GRINDING:**
  1. **GRINDING A CUT-TO-POINT CYLINDER WIRE:**

     1. Wire points of cylinder have become finer and the tip is cut-to-point.Because of this new profile,
        it has beccome necessary to recommend a little or no grinding of the cylinder wire following mounting.
        TSG grinding machine of GRAF(wire manufacturer) can be used to sharpen these modern wires.
        TSG grinding is a safe method of grinding.
     2. Before grinding , the wire should be inspected with a protable microscope to ascertain the wear. Based on
        this and the wire point land width, no of traverse for TSG grinding should be decided. If the width of
        the wire point tip is bigger and the wear out is more, the number of traverse during grinding should be more.
        For a new wire, 3 or 4 traverses may be enough. But it may require 10 to 30 traverses for the last grinding
        before changing the wire, depending upon the maintenance of the wire.
  2. GRINDING A NORMAL CYLINDER AND DOFFER WIRE:

     1. The first grinding of the metallic wire on the cylinder and doffer is the final and most important step leading
        up to providing the card with a cylinder in the best possible condition for carding well at maximum produciton
        rate.Grinding the lands of the teeth provides the leading edge of each tooth with the final sharpness reqauired
        for maximum carding power.
     2. The first grinding should be allowed to continue until at least eighty percent(for cylinder) and 100% (for doffer)
        of the lands of the teeth have been ground sufficient to sharpen the leading edge of the tooth.
     3. To ascertain this stage of grinding, it is necessary to stop the cylinder regularly and use a simple
        microscope to examine the teeth at random across and round the cylinder.
     4. If the wire on the cylinder is of good quality and has been correctly mounted, the initial grinding
        period should be completed with in 20 min.
     5. It is essential to avoid over-working the wire before taking corrective action. The regrinding cycle
        must be determined accurately for the conditions applying in the individual mill, by using the microscope.
     6. If regrinding is done properly, there are several advantages
        1. carding quality will remain consistent
        2. There is no risk of overworking the wire
        3. Time required for regrinding is very short
        4. The exact condition of the clothing is known
        5. The working life of the wire is likely to be longer because the points are never allowed to become worn
           beyond recovery

7. To obtain acceptable grinding conditions at the low grinding speed, the grindstone must always be
   SHARP, CLEAN and CONCENTRIC. If the grinding stone is gradually allowed to become dull and glazed
   through constant use, the limited cutting action available will eventually disappear, resulting in burning
   and hooking of the carding teeth.
8. Due to the low peripheral speed of the grindstone which has to be used, it is most important that the
   speed of the wire to be ground is as high as is practicable to provide a high relative speed between
   the grindstone surface and the cardig teeth.If wire speed is low, the individual carding tooth spends too
   long a time in passing under the grindstone, thereby increasing the risk of hooking and burning the tooth,
   which is usually irreparable.
9. With cylinder grinding, speed is no problem because the normal operating speed of the cylinder is more
   than sufficient. The speed of the doffer for grinding is more commonly a problem and this should be driven
   at a minimum speed of 250 m/min, to avoid damage when grinding the wire, the design which is particularly
   susceptible to hooking due to the long fine, low angled teeth needed on the doffer.
10. The directions of rotation for metallic wire grinding are normally arranged so that the back edge
    of the tooth is first to pass u nder the grindstone. This is termed grinding "back of point"

3. **GRINDING FLAT TOPS:**
   1. Flat tops provide the opposing carding force against the cylinder wire and hence can equally effect
      carding quality.It is essential to ensure that the tops are kept in good condition to maintain maximum
      carding power with the cylinder.Again, the only reliable approach is to examine the tops with the
      microscope and decide whether grinding is required or not.
   2. For cards fitted with regrindable tops, it is good practice to regrind the flats at regular intervals
      thus ensuring that the conditions of the two principal carding surfaces are always complementary one to other.