1. **FIBRE PROPERTIES AND SPINNABILITIES**

Based on the technology of processing, we differ between, cotton spinning, wool spinning, semi worsted and worsted yarn spinning.

The producer of Man-Made fibres and in particular the producer of Viscose Staple Fibre can offer a particular type of fibre according to technology of processing and quality required of spun yarn. Of course, there is a certain overlapping of types, i.e. modern textile machinery permits the production of the same type of fibre according to different processing methods. In the most cases this will also mean a different yarn character, even-though, sometimes it is the higher productivity of the spinning process that is the determining factor.

Experience and sales figures in Indonesia show that the major buyer of Viscose Staple Fibres today is still the cotton spinner. Therefore, this lecture shall thoroughly deal with processing Viscose Staple Fibres according to the cotton spinning process.

1.1. **PHYSICAL FIBRE PROPERTIES**

   The very importance thing in spinning is to have knowledge on the raw fibres properties to be used and their spinnabilities.

1.1.1. **Hygroscopic properties**

   Cellulosic fibres like cotton and rayon have high hygroscopicity to atmospheric temperature and humidity. On the other hand synthetic fibres like Polyester have generally low hygroscopicity. On the temperature 25°C and 65% RH. The moisture regain on rayon is 12% to 13% and cotton 7%, the polyester is as low as 0.4%. Hygroscopicity generates static during spinning process and affects spinnability and brings a degree of changes in moisture regain of the fibres at various temperature and Re. Humidity.

   The graph shown below is the hygroscopicity curves of various fibre at 25°C.
1.1.2. Static charges
Friction among fibres or between fibre and metal during spinning sometimes generates and builds up static electricity especially with the fibre of lower hygroscopicity. Usually antistatic oil had been added during manufacturing Polyester and Rayon in order to have the same spinnability as cotton fibre, by maintaining the temperature between 20 – 28°C and 55 to 70% of RH, will not generate much problems in spinning process.

1.1.3. Friction
As mentioned above that friction may cause troubles in spinning process and affects the spinnability either. The higher coefficients of friction will produce problem in card action and draft effects but the lower coefficient will cause less cohesion among the fibres and will affect yarn strength (lower or in sufficient). Polyester fibres have highest coefficients of friction followed by Rayon then cotton. Polyester and Rayon are given oiling treatment during process in order to get the sufficient coefficient of friction.

1.1.4. Crimp
To increase of friction among the fibres and the cohesion, to improve bulkiness, elasticity and spinnability, certain degree of crimps are applied to the man-made fibres.
Polyester as well as Rayon, bright and semi dull are crimped.
The rayon with smaller number of crimp is called “Regular Rayon Staple” and “Crimp Rayon Staple” is the Rayon with higher degree of crimp.

1.2. SPINNABILITIES OF FIBRES
This is describes various properties of the fibres related to their spinnabilities in particular. The details of the related subject are explains in the next article.

2. SPINNING OF 100% RAYON

2.1. RAW MATERIAL SELECTION
Fineness, fibre length, tensile strength, friction, elongation, static charge and moisture regain are the important factors for spinnability. This offer the liberty of selecting a proper viscose material will meet the characteristic to the spinning method and condition.

As regards the correct flake humidity of the Viscose Staple Fibre for cotton spinning, it can be said that incase of regenerated cellulose staple fibre optimum processing and yarn properties were obtained with a material humidity between 11-14% for which 50-60% RH and temperature of 26-30°C should be maintained in the spinning room.

In developing the primary finish of the fibre, fibre producers have, however, seen to it that even in countries of extreme climatic conditions good processability of Viscose Staple Fibre and good yarn quality is ensured. The following points are to be considered while selecting the raw material.
2.1.1. TYPES OF MATERIAL

PT. South Pacific Viscose offering the fibre of “Regular type” and High Tenacity type” both types of the fibre are available in following specification.

<table>
<thead>
<tr>
<th>Denier</th>
<th>1.2 to 2.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Staple length</td>
<td>32 mm to 76 mm</td>
</tr>
<tr>
<td>Lustre</td>
<td>bright, semidull or dull</td>
</tr>
</tbody>
</table>

When the lustre product is preferred the “Bright type” usually chosen and for soft and matt appearance “Dull” or “Semidull type” is used.

Our Group (Lenzing Group) also offer various Viscose fibre type as mention below

- Regular fibre
- High Tenacity fibre
- Modal fibre
- Micro-Modal fibre
- Spun-dyed fibre
- Flame retardan fibre
- Lyocell fibre

2.1.2. FINENESS AND FIBRE LENGTH

The selection of fibre length should be related to the size and use of yarn to be spun, type of the cradle of the spinning machine and the fibre fineness as well. Less number of fibre per cross section of yarn will result in sufficient strength and degrade spinning condition, but the extreme relation between fineness and fibre length will cause damage to the fibre and draft troubles, creating difficulty in Spinning process or produce the neppy yarn.
To meet less difficulties in spinning then the following condition (ideally) is to be considered:

a. **Fibre length (mm)** < 4.000 or **Fibre length (inch)** < 1
   
   **Fibre dia (mm)** or **Fineness/denier**

b. **Number of fibres per cross section of yarn** > 60

c. **Fibre per cross section** = \[ \frac{9000}{\text{Nm Yarn} \times \text{Fibre denier}} \]

Diagram of spinning limit of rayon staple (JCFA information service 1980).

Fig. 3. **Spinning limit as a function of fibre finess**

1. The vertical line indicate the limited spinning count (Ne)
2. The horizontal lines indicate the fibre denier/dtex.
3. The curves indicate the number of fibre per cross section.
2.1.3. SPINNABILITIES

As we know that rayon fibre has higher hygroscopicity than cotton and also has a different static electrical properties since then the rayon fibre are more severely affected by the room condition (the temperature and Rel. Humidity) than cotton fibre.

To provide satisfactory spinnability under normal condition the Viscose fibre, have been oiled to have better control of static charge and frictional properties. However, the choice of fibre length and other characteristic in cotton spinning is limited and depend on the machine condition and equipment own by the spinner, the specification of rayon may be chosen within the range shown in diagram No.1, of course after taking into consideration, the fibre properties mentioned above related to yarn to be produced.

Example: For fibre of 2d x 51mm the spinning limit is

\[ Ne = 2.41 \times L \times d^{-3/2} \]

Where
- \( Ne \) = Yarn count
- \( L \) = Fibre length
- \( d \) = Fibre denier

2.2. SPINNING EQUIPMENT

As far as the processing of Viscose Staple Fibre according in the cotton spinning system is concerned, this fibre can be processed on the conventional spinning equipment, without any major modifications, however, some adjustment are necessary to get better result.

2.2.1. OPENING AND SCUTCHING

For technological and economical reasons, the producer of man-made fibres is forced to press the Viscose Staple Fibres in to bales of high density. Owing to this, the fibre must be given sufficient time before processing to recover from the high compression. This means that the bales are opened several hours before processing and kept unpacked in a room condition to the spinning climate.

Man-made fibres in general and viscose staple fibre in particular, unlike natural fibres, are free from impurities and dust or other foreign matters. Therefore, Viscose Staple Fibre need not be cleaned but only properly opened. This dissolution which mainly takes place on the scutcher should, however, cause no damage to the fibre by too intensive working beaters.
If only scutchers with 2 beaters are available, as they are usually used in cotton spinning, both of them should be Krischner beaters, excessive beating is undesirable as it damage the fibres.
In practice, a plant consisting of several blenders, a double hopper feeder with filling box and scutchers with a Krischner beater and lapping machine has proved successful.

2.2.2. CARDING

Viscose staple fibre can be process both on cards of conventional design or high production card. Depending on the weight of sliver and take-off speed, an output between 6-40 kg/hrs and more can be obtained.
High production cards, it is true, cause a slightly increased shortening of the fibre staple as compared to conventional cards, but this not much affecting the yarn quality.

Card setting of fibre length of 38mm or less is approximately the same as that for cotton, whereas for the longer fibre the recommendation of machine manufacturer is to be consider with a slight adjustment. A wider setting of flats must be chosen to avoid the fibre rupture and excessive wastages.

The same is true for fibre blend with synthetic, nowadays, mainly steel wire card clothing are used. Make sure the clothing is well ground and trouble free condition. For gentle treatment of the viscose staple fibre and in order to avoid damage to the fibres using of a negative position of steel wire in licker-in is strongly recommended.

2.2.3. DRAW FRAME

The same Drawing frame for cotton may be used for rayon staple, however processing viscose staple fibre of cotton type is also possible on commercial Drawing machines with delivery speed of up to 500 mm/min on high-production Drawing-frames. Doubling will be 6-8 times and 2 drawing passage are sufficient for pure spinning of viscose staple fibre.

Synthetic coatings of a shore hardness of 80-84° have proved successful as top roller coatings.

Lacquers pressure roller coatings will be necessary only under extremely unfavourable climate conditions. Fibre preparation for all man-made fibres usually include anti-static substances so that “Lap-formation” caused by static charges does not occur even at high delivery speed and extremely low relative air humidity.

2.2.4. SPEED FRAME (ROVING)

The processing of Viscose Staple Fibre in the speed frame (high draft speed frame) present no problem either. The 2-zone drafting system or the double apron-drafting systems are just suitable as the 3 over 4 drafting system. On the speed frame, too,
the setting recommendations by the machine producers should be considered. Recommendations for setting the drafting system are suggested in “The care for spinning operations”.

2.2.4. RING FRAME (SPINNING)

The nowadays usually double-apron system has proved successful on the Ring-spinning machine but also single-apron and other drafting system. That are occasionally still in use, are suitable for processing Viscose Staple Fibre and its blend. Depending on the type of drafting system drafting up to 50 times is possible according to the requirement to meet by the yarn.

2.3. CARES FOR SPINNING OPERATIONS

This section covers details of operation, in each process and practical solution for possible problems.

2.3.1. GENERAL

(a) TEMPERATURE AND HUMIDITY

The most important factor control to obtain satisfactory operating condition is maintaining the optimum temperature and humidity condition.

It was explain in previous chapter that rayon staple is most sensitive to temperature and humidity than cotton, higher RH than cotton will give better performance and too low RH may generate static charge which may affect troubles in spinning process.

(b) The following tables in the standard temperature and Re. Humidity condition as well as the min. condition on each section (JCFA) (especially for tropical condition).

<table>
<thead>
<tr>
<th></th>
<th>Standard Condition</th>
<th>Minimum Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Temperature</td>
<td>Re. Hum.%</td>
</tr>
<tr>
<td>Opening/Blow-room</td>
<td>27° ± 3°C</td>
<td>60% ± 3%</td>
</tr>
<tr>
<td>Carding</td>
<td>27° ± 3°C</td>
<td>60% ± 3%</td>
</tr>
<tr>
<td>Drawing</td>
<td>27° ± 2°C</td>
<td>55% ± 3%</td>
</tr>
<tr>
<td>Spinning</td>
<td>28° ± 2°C</td>
<td>55% ± 3%</td>
</tr>
<tr>
<td>Winding/twisting</td>
<td>27° ± 3°C</td>
<td>65% ± 5%</td>
</tr>
</tbody>
</table>

Our Viscose fibre has been treated at the factory to permit setting of the same cotton condition as far as possible. However if it is not posible to maintain the temperatur and Relative Humidity due to mill condition or local climate, then troubles in spinning are anticipated, the proper remedy is necessary as shown on “Cause and Remedy “ in the next chapter.
Rayon staple can be best spun when it has moisture regains of 11 – 14%, it is therefore desirable to check the moisture regain before processing.

2.3.2. RAW MATERIALS

Careful processing of Viscose Staple Fibre aimed at optimum processing conditions and optimum yarn qualities begins with bale preparation and blending in the spinning plan.

(a). STORAGE

It is strongly recommended to store the raw fibres in-doors, with less temperature and humidity fluctuation and not to store them out-doors or under simple shelters where various external condition will expose.

(b). OPENING THE BALES

Bales should be opened in either blow room or opening room. The opened bale should be left in the place where they were opened, for at least 24 hours, to let the properties of raw fibre conditioned to the existing environments, to let the fibre recovers from high compression to compensate any possible variation in fibre humidity within the bale and bale to bale variance as well.

(c). BALE MIXING

Owing to their production Viscose Staple Fibres have a fairly uniform fibre character (titre) and fibre length (fibre staple). However, Viscose Fibre is produced from natural based, variation of certain fibres properties, such as colour (whiteness) strength, dye ability etc, cannot fully be avoided.

This criteria will be of importance, where the quality of end product must meet very high requirement. It is therefore necessary to use a wide blend of bales supplied. In practice the smallest suitable unit has proved to be a blend of at least 20 bales. If a blend is spun as a separate batch, it must be treated as a complete processing batch right from fibre spinning to yarn processing in the weaving or knitting section.

If several supplies, which were produced in the factory at different times are to be processed, then the said different supplies must be blended over lappingly e.g. in case of bales per spinning batch:

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1&lt;sup&gt;st&lt;/sup&gt;</td>
<td>supply</td>
<td>total bales on laydown</td>
</tr>
<tr>
<td>2&lt;sup&gt;nd&lt;/sup&gt;</td>
<td>supply</td>
<td>total bales on laydown</td>
</tr>
<tr>
<td>3&lt;sup&gt;rd&lt;/sup&gt;</td>
<td>supply</td>
<td>total bales on laydown</td>
</tr>
<tr>
<td>4&lt;sup&gt;th&lt;/sup&gt;</td>
<td>supply</td>
<td>total bales on laydown</td>
</tr>
</tbody>
</table>

12 bale  
10 bales  
8 bales  
6 bales
As soon as the first supply has been consumed, the next one i.e. the 5th supply should be blended and the number of bale shifts as previously mentioned, then the next batch will be:

<table>
<thead>
<tr>
<th>Supply</th>
<th>Total Bales on Laydown</th>
</tr>
</thead>
<tbody>
<tr>
<td>2nd</td>
<td>12 bales</td>
</tr>
<tr>
<td>3rd</td>
<td>10 bales</td>
</tr>
<tr>
<td>4th</td>
<td>8 bales</td>
</tr>
<tr>
<td>5th</td>
<td>6 bales</td>
</tr>
</tbody>
</table>

**The bales Scheme**

If the recovered fibre to be re-mixed, they must be fed in the specified amount and specified method and this must be carefully done to achieve even dispersion feeding and also to avoid accidental mixing of other types of fibres.
(e). HANDLING OF RECOVERED AND WASTES

It is very important to strictly divide the re-use waste by kind into: lap-bit, sliver-waste from different passages, roving waste and peunemafil waste, in order to prevent mixing with other fibres, storages place and handling equipment must be separately prepared. Even though rayon staple fibre produced much less waste, the same is true, that unusable waste should be grouped by type with a very clear identification.

(f). PREVENTION OF MIXING WITH OTHER FIBRES

The accidental mixing between two types of fibre or more will generate the defect in the products, since there are the differences of the characteristic of the fibres, such as rayon staple fibre, cotton or polyester, includes their dye ability. Prevention of mixing with other fibres is therefore one of the important control, the following steps may be taken:

1. Cover lap with different plastic cover or put different color of dot on the side of lap.(used direct dyes or tinting material).
2. Mark the card can permanently (with paint) or temporary (with colored plastic, paper band) to identify the card sliver in the can.
3. The same is applied for 1st passage and second passage of drawing frame.
4. If possible use the different color of speed frame bobbin for each type of process or put different color of plastic ring on bobbin, or mark the roving with marking chalk or stamp.
5. Used different colored of spinning tube of mark the yarn on tube with chalk mark.
6. Colored the nose of the cones before winding, one color for each type of product.
7. Prepared the different place for storing the waste or re-use waste of each type of product.
8. Never the last all staff n Spinning Department from the highest to the lowest level should be informed precisely regarding the above prevention.

2.3.3. OPENING AND SCUTCHING

1. STANDARD EQUIPMENT

In opening and scutching of rayon fibre they are a lot of choice of various equipment combination, but as mentioned before that the cleaning equipment which may have attend to damage the fibre should be by passed. The normal equipment usually used for processing rayon staple in cotton spinning system is: conveyor lattice – hopper mixer – hopper bale breaker (synth. Bale opener) – hopper feeder – scutcher.
2. STANDARD OPENING CONDITION

The following is an example of standard spinning condition of rayon staple fibre, the finer yarn count the lighter parameters are desirable.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lap weight</td>
<td>oz/yds</td>
<td>12 to 14</td>
</tr>
<tr>
<td>Total weight</td>
<td>lbs</td>
<td>40 to 50</td>
</tr>
<tr>
<td>Lap length</td>
<td>yds</td>
<td>35 to 45</td>
</tr>
<tr>
<td>Beating point</td>
<td></td>
<td>2 to 3</td>
</tr>
<tr>
<td>Beating per inch fibre</td>
<td>rpm</td>
<td>30 to 40</td>
</tr>
<tr>
<td>Lap roller speed</td>
<td>rpm</td>
<td>10 to 12</td>
</tr>
<tr>
<td>Callender pressure</td>
<td>kp</td>
<td>2000 to 30</td>
</tr>
<tr>
<td>Beater revolution</td>
<td>rpm</td>
<td>600 to 800</td>
</tr>
</tbody>
</table>

3. PREVENTION OF THE FIBRES DAMAGE

(a). HOPPER
- Maintain the ratio between spike and bottom lattice or around 10 : 1 to prevent flocking of the stock.
- Maintain the pins of spike lattice and leather/plastic blade beater, to minimize the return stock.
- Adjust the feeding device to feed just the sufficient volume to the hopper to reduce the return stock of the fibre.

(b). BEATER
- Krischner beaters are preferable.
- Maintain wider gauge between the feed rollers and the beater.
- Low numbers of beats per inch is recommended, around 30 to 40.

(c). To improve the fibre separation after beater the fan speed should be 20% higher than beater speed and also should be higher than that for cotton

4. PREVENTION OF THE LAP LICKING

- Increase the callender roller force by 20%
- Use of finger licking preventer.
- Insert the roving in between the layer’s, about 4 to 6 rovings (maintain, the equal tension and equal distance of each roving from one edge to another).
- Increase the cage fan speed to suck more air into top cage, the ratio of stock on the top and bottom approx 3 : 1.
5. CHUTE-FEED SYSTEM

Direct feeding on the card (chute feed system) can be used to eliminate the risk of fibre damage.

The below precautions are to be followed:

- The inside duct must be cleaned prior to feeding the fibre to the machine.
- The inside duct should be very smooth free from blocking especially at the joint.
- The fibre has to pass the duct smoothly to avoid the entangle fibre.

2.3.4 CARDING

As mentioned before that card clothing is one of the importance point to be considered will not repeat in this section.

Due to high friction in card machine, fibre are founds to be ruptured in carding process, here we discuss some points to prevent the fibre damages.

(a). SLIVER WEIGHT

The heavier sliver weight will cause the damage of the fibres. The sliver weight between 350 to 400 grain/6 yard usually give satisfactory result in the process.

(b). REVOLUTION PER MINUTE

- Generally the speed in processing rayon staple is similar as for cotton, even higher a doffer speed is recommended around 10 rpm for conventional card and approx 24 rpm even on latest model could go up to 40 rpm for high card production, with production range between 6-40 kg/hr depending on the weight of sliver.
- Taker in speed between 300 to 500, or slower speed than for cotton. Using the negative wire is recommended.
- Flat speed can be lower than for cotton.

(c). GAUGE

The gauge on the card for man-made fibres usually slightly wider than for cotton, depending upon:

1. Staple fibre length and fines used
2. The precision of the card
3. Card clothing
4. The volume and speed of fibres passage
The following point is the important point to gauge precisely.

<table>
<thead>
<tr>
<th></th>
<th>Diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Doffer</td>
<td>5/1000&quot;</td>
</tr>
<tr>
<td>Flat</td>
<td>10/1000&quot; - 15/1000&quot;</td>
</tr>
<tr>
<td>Dishplate</td>
<td>10/1000&quot; - 15/1000&quot;</td>
</tr>
<tr>
<td>Taker in</td>
<td>7/1000&quot;</td>
</tr>
</tbody>
</table>

**Figures: No. (Page .....)** show the card setting for a high production flat card. This setting can be regarded as approximate values for processing Viscose Staple Fibres. Rayon slicker than cotton, since then the pressure of the feed rolls should be carefully check to avoid uncontrol fibre drawn by the taker-in which will creating machinery problem or more variation of card sliver.

(d). Temperature and humidity should be properly control it will causes the broken ends of web or licking on to the doffer if room humidity is lower or otherwise cause rag web which will also generate processing problem.
2.3.4. DRAW FRAME

The main objects of drawing are to put fibres in parallel each other and improve the uniformity of the sliver size, more cares are applied than for cotton processing due to fibre characteristics.

(a). ROLLER GAUGE
The setting of the drawing frame is, a rule, recommended by the machine producers and certain preliminary tests with certain type of Viscose Staple Fibre, soon show the optimum values that can be attained.

The rayon staple fibre have higher elongation, uniform length and fineness, therefore the roller gauge should wider than for cotton, of course also based on the consideration of the fibre length and the amount of the sliver which is passed the draft-zone.

Recommendation for setting up to date drawing frames are given in :

![Diagram of Drawing Roller Settings]

**Fig. NIP TO NIP GAUGE SETTING**
<table>
<thead>
<tr>
<th>DRAFT TYPE</th>
<th>STANDARD GAUGE</th>
<th>MODELS</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) <strong>4 OVER 4 ROLLER</strong></td>
<td>( A \times B \times C) [= (L+3) \times (L + 5 \text{ TO } 8) \times ) (L + 8 \text{ TO } 16)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b) <strong>4 OVER 5 ROLLER</strong></td>
<td>( A \times B \times C \times D \times S = ) ((L - 3) \times (38) \times (L + 6 \text{ TO } 10) \times ) (L + 8 \text{ TO } 16 \times (40 \text{ TO } 70 / 100))</td>
<td><strong>TOYODA DK 8</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>DK 9</strong></td>
</tr>
<tr>
<td></td>
<td>(A \times B ) [= (L + 4 \text{ TO } 6) \times (38) \times (L + 4) \times ) (L + 8 \text{ TO } 10 \times (3))</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(\times (3))]</td>
</tr>
<tr>
<td>(c) <strong>3 OVER 5 ROLLER</strong></td>
<td>( A \times B \times C \times S = ) ((L - 3) \times (38) \times (L + 6 \text{ TO } 16) \times ) (40 \text{ TO } 70 / 100))</td>
<td><strong>TOYODA DK 8</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>DK 9</strong></td>
</tr>
<tr>
<td></td>
<td>(A \times B \times C \times S )</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Hara Shokki</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Cherry</strong></td>
<td></td>
</tr>
<tr>
<td>(d) <strong>4 OVER 4 ROLLER, WITH PRESSURE BAR</strong></td>
<td>(A \times B \times C \times S = ) ((L + 4 \text{ TO } 6) \times (38) \times (L + 4) \times ) (L + 8 \text{ TO } 10 \times (3)) [\times (3)]</td>
<td><strong>Hara Shokki</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Cherry</strong></td>
</tr>
<tr>
<td></td>
<td>(A \times B \times C \times S )</td>
<td></td>
</tr>
<tr>
<td>(e) <strong>5 OVER 3 ROLLERS</strong></td>
<td>(A \times B) [= (L + 13) \times (L + 14 \text{ TO } 25)]</td>
<td><strong>ZINSER</strong></td>
</tr>
</tbody>
</table>

**Fig.** Centre to Centre Setting
Another drawing gauge
b). **SLIVER WEIGHT**

The sliver weight between 350-420 grain/6 yards usually give better quality and higher drafting efficiency, however, the sliver weight should be determined in connection with the before and after process.

A lighter weight is preferable since the heavier sliver sometime can be cause for tube coiler choking.

Experience show that by increasing 20 – 30% of roller pressure than for cotton obtain the better result. It is recommended to set the roller wider if increasing pressure is not possible, or the sliver weight made lighter.

(c). **LAPPING (LICKING)**

The lapping or licking or sticking fibres on the roller is the most often troubles in Drawing-frame it is sometime due to room condition (Rel.Humidity) or condition of rubber cots on top rollers.

Man-made fibres includes rayon, in general, causes staining damaging rubber cot of top roller more often than cotton, because of oiling agent dislodged from stock, therefore if licking occurs, cleaning of the roller surface with ethanol or methanol is required, detailed remedies for licking and rubber cot treatment will be explained hereon (page ….. and ….)

The use of cot meet the characteristic of rayon in term of electric properties, abrasion resistance, hardness and smoothness is recommended, if the cots for cotton are to be used it is very important to maintain:

- The smoothness of the roller surface
- Regular cleaning from stain oil
- Prevent from the sharp items.

Licking occurs not only on top rollers but sometime on bottom rollers also, this case mostly due to:

- Rust formation on the roller and deposit of water or moisture because of excessive room humidity.
- Oil stain
- Imperfect roller contact
- Damage fluted roller

In this case it is very important in maintaining the roller surface polished and cleaned perfectly.

Talc powder in practice can be used but this only for temporary and might affect the yarn quality.
2.3.5. SPEED FRAME (ROVING)

As describe earlier that processing rayon staple in Speed Frame principally is the same with cotton, however, the determining of number of twist and roller gauge have to be considered thoroughly.

(a). DRAFT
The draft below 10 times is preferable and usually good in result both production quality and the processing as well, the heavier roller weight than for cotton is preferable.

(b). ROLLER GAUGE
The determination of roller gauge in roving are same as applied to the principle of Roller Gauging in Draw Frame and Recommendation for setting the drafting system from the machine manufacturers are to be followed, however, in Figure 3a (Nip to Nip) and Figure 3b (centre to centre) are given for comparation purpose.

(c). TWIST
Roving twist should be only high enough to prevent drafting difficulties on the subsequent Ring Spinning machine, generally lower than for cotton.

The optimum twist will be determined by denier fibre length, roving count and drafting condition in ring frames. The twist multiplier within the range of 0,5 to 0,8 will be sufficient and will not create troubles in ring frame.

(c). To avoid the slack roving on the bobbin since rayon staple fibre is more slicker than cotton, a greater taper of roving bobbin is recommended.

(d). All the surface where the roving are passed must be kept clean and very smooth, especially flyer fingers where the fibre will be arrested if there are scratches or nicks on the surface which will affect the roving quality an further will affect the processing condition.
ROLL SPREAD FOR SPEED FRAME

TWO ZONE DRAFTING SYSTEM

NOTE:
* 40 MM CUT LENGTH
** 60 MM CUT LENGTH

DOUBLE APRON DRAFTING SYSTEM

ANOTHER DRAFTING SYSTEM
2.3.6. SPINNING
As mentioned in earlier page that all types of cotton ring spinning can be used for rayon processing. In processing 100% rayon all cares as mentioned before should be taken into consideration. The troubles usually occur up to draw-frame stage, should be solved, then in spinning only concentrate for production and better quality of yarn.

The cotton type Viscose Staple Fibre as it is on the market today, permits spindle speed of up to 16,000 rev/min and above for pure spinning, which corresponds to a ring traveller speed of approx 32-40 meter/sec and a high out put.

The following suggestions are for the better operation in Ring Frame stage.

(1). ROLLER GAUGE
The same principle that roller gauge for 100% rayon should be wider than for cotton and the roller weight should be slightly heaviers, the roller presser and correct selection of cage support must be adapted to the required yarn count, total draft, roving count, roving strength, roving twist, we recommend a break draft of 1.15 to 1.38. However the recommended setting from machinery manufacturer is to be considered and of course mill experiences is also an advantage. Figure no.4 is an example for setting of double apron drafting system.
(2). TWIST

The right yarn twist is decisive for complete utilization of spinning capacity and also obtaining excellent yarn values.

Therefore, the yarn twist was determined for. The South Pacific Viscose Staple Fibre at which best utilization of machine, capacity and yarn tenacity is ensures. The two lines shown in Fig.6 for a fibre staple of 44mm limit the top and bottom range of optimum twist. As you will know yarn tenacity decreases outside this range and causes a rise in the number of yarn breaks, soft ends. It will be increases the curls in the yarn in case of excessive twist. For spun rayon yarn its strength increases to a certain point as the twists increases, but an increase of twist beyond that point will result curly yarn or too excess twist will only result in decreasing of productivity.

However, the twist multiplier of the yarn must be decided by judging various factors such as fibre’s characteristic, efficiency of spinning, quality yarn, but the ultimate usage of the yarn, i.e. the touch of the fabric is the most important factor. Therefore in ring spinning the wide range of twist change gear should be available.
(3). **ROLLER AND APRONS**
Roller and aprons should be in a good condition, and to be maintained as describe in the next session.

Hardness and type: ……………………………

(4). **PNEUMAFILE**
Pneumafil duct and pneumafil tube should be check regularly from fibres chocking, as good suction of this equipment will help in avoiding fibres lapping in the rolls when ever yarn breaks are taken place.

(5). **THE RING TRAVELLER**
The suitable ring traveller is to be chosen as per the manufacturer recommendation.

(6). **THE SURFACE AND MACHINE CLEANLINESS**
The surfaced of machine’s part where the roving run must be kept smooth and clean to avoid nabbing of the fibres.
The room inside the machine should be free from dirties or flies, the accidental spun flies or dirties will affect the bad yarn evenness and after all degrade the yarn quality.

(7). **TEMPERATURE AND REL. HUMIDITY**
Last but not least the controlling of temperature and rel. humidity is very important as explain before that rel. Humidity could severely affect the processing condition.
### 2.4.1. LAPPING CAUSES AND REMEDY

<table>
<thead>
<tr>
<th>Cause</th>
<th>Responsible conditions</th>
<th>Suggested remedy</th>
</tr>
</thead>
</table>
| 1. Statistic electricity                    | - Spinning humidity too low  
   - In sufficient oil content  
   - Moisture regain of raw mate rial in sufficient | - Maintain optimum temperature and rel. humidity condition.  
   - Condition the fibre  
   - Re-oil  
   - Lower roller speed temporarily  
   - Lighter weight of sliver |
| 2. Deposit of sticky material               | - Surface stain by build up of oily substances  
   - Stick by tackiness of oiling agents at high temperature and humidity  
   - Deposit tacky non-oil minute particle substances  
   - Dew stain due to excessive humidity | - Maintain optimum temperature and humidity conditions  
   - Lower humidity  
   - Clean surface with ethanol, methanol  
   - Chemical treatment of roller surface  
   - Scuttered put in staple fibre from the same lot |
| 3. Abnormal surface of rollers and aprons   | - Roughened of roller or apron  
   - Cracker or scored  
   - Dislodged rubber cot  
   - Worn rubber cot/apron | - Regrind and chemically treat roller surface  
   - Replace defective roller - or apron |
| 4. Incorrect                               | - Imperfect contact of cleaner control with roller  
   - Disordered fleece edges due to incorrect collector width  
   - One side lifting of roller weight | - Readjust cleaner  
   - Readjust collector width, change by a suitable collector  
   - Readjust roller arm weight |
### 2.4.2. MAINTENANCE OF RUBBER COT AND APRON

#### Rubber cots

**Solution**
- 1. Luke warm water
- 2. Neutral detergent
- 3. Gasoline

<table>
<thead>
<tr>
<th>Front</th>
<th>Second</th>
<th>Third</th>
<th>Back</th>
</tr>
</thead>
<tbody>
<tr>
<td>mth</td>
<td>mth</td>
<td>mth</td>
<td>mth</td>
</tr>
</tbody>
</table>

**Interval of Cleaning**
- Dr. Frame: 0.5 – 1 mth
- Roving: 1 mth
- Spg: 1-2 mth

**Procedure Of cleaning**
1. Put roller on a stand and wipe roller surface with cloth soaked with Luke warm detergent
2. Remove water with dry cloth

*Note:* in case of heavy stain treat the roller with one of the two system below:

- a. Apply neutral detergent then treat with Luke warm
- b. Apply with Luke warm then treat with gasoline (clean roller properly from any stain of gasoline before fixing on the machine).

#### Rubber aprons

**Solution**
- Neutral detergent

**Interval of Cleaning**
- Top: 2 mth
- Bot: 6 mth

**Interval of Cot buffing**
- Dr. Fr.: 3-6 mth
- Rov.: 6 mth
- Spg: 6 mth

**Procedure Of cleaning**
1. Put Luke warm 1% detergent solution into an electric washing machine and agitate 10 to 15 minutes.
2. Thoroughly rinse
3. Air dry in the shade.
## 2.4.3. MAINTENANCE OF RUBBER COT AND APRON

<table>
<thead>
<tr>
<th>Rubber cots</th>
<th>Aprons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solution</td>
<td>Concentrate Sulphuric Acid</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Standard Interval</th>
<th>Front 6-8</th>
<th>Second 6-8</th>
<th>Third 6-8</th>
<th>Back 6-8</th>
<th>Top 6-8</th>
<th>Bott 6-8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. Fr.</td>
<td>3-6</td>
<td>6-8</td>
<td>6-8</td>
<td>6-8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rov.</td>
<td>6-9</td>
<td>6-9</td>
<td>6-12</td>
<td>6-12</td>
<td>Rov 6</td>
<td>6</td>
</tr>
<tr>
<td>Spg</td>
<td>6-9</td>
<td>-</td>
<td>-</td>
<td>9-15</td>
<td>Spg 6</td>
<td>6</td>
</tr>
</tbody>
</table>

### Procedure
1. Wipe roller surface (using rubber solvent benzine, unleaded gasoline or detergent) 1% detergent solution
2. Put conc. sulf. acid (95%) into a porcelain enamelled ware to a dept of 1.5 mm
3. Immerse only rubber portion of roller in solution and rotate about 5 seconds to apply the acid evenly
4. As early possible after treatment rinse about 10 minutes by rolling on glass plate on which water is let to run
5. Neutralize by rolling 4-5 times on cloth soaked with neutralizing solution of 1000 cc water and 50 cc ammonia
6. Rinse in the same manner as no. 4
7. Wipe away water from roller surface with dry cloth.

### Precautions.
1. Wear rubber gloves, mask and apron to keep the hand, face and clothing to avoid from with the conc. Sulf. Acid, Rinsing immediately with volumes of waters if contacted
2. Pour sulphuric acid into water slowly and not in contrary.
3. Avoid the contact of solution with iron.

### Important
1. Excessive treatment may crack the rubber
2. Provide ventilation for sufficient fresh air.

The above treatment is recommended after every buffing / grinding
3. BLENDING WITH OTHER FIBRES

Viscose staple fibres of high qualities, as they are today offered by well-know man-made fibre industries especially South Pacific Viscose fibres of course, are not only suitable for pure mixing, but in particular also for production of high quality blends with cotton or polyester and also with other fibre.

According to the requirements to be met by the product one can chosen between normal fibre, high tenacity viscose staple fibre and high wet modulus fibre, and also specially crimped fibre etc. possibilities for development are, therefore manifold.

IMPORTANT
Fibre blend with natural fibres such as cotton, wool etc and man-made fibres must extremely homogenous because of their sometimes very different dye abilities. So as not to face the dyeing or finishing with insoluble problems.

3.1. SPINNING OF COTTON RAYON BLENDS

When Viscose Staple Fibres are blend with Cotton, a better yarn and fabric appearance is generally obtained than if pure cotton is used. The product obtains a silky lustre, a soft handling and attractive color. Since the elongation of viscose staple fibre (cond.) is higher than that of cotton, in the certain cases the blend will have slightly lower or higher yarn tenacity than 100% cotton, depend upon the blending ratio.

The normal South Pacific Viscose staple fibre is characterized by a lower fibre elongation viscose staple fibres which favourably manifests itself in an increase in tenacity in blends of up to about 40% viscose staple fibre.

If one wishes to improve the appearance of on established article without altering its properties, the proportion of respective component should not be too high.

If one wants the article to retain the handle characteristic of cotton, only a little softer and more draping even after a number of washing process the proportion of 50% viscose staple fibre to cotton is recommended.

3.1.1. SELECTION OF RAW MATERIAL

The length of the Viscose Staple Fibre to be chosen according to the staple length of the cotton used. In order to obtain an improvement of the whole staple and thus better processing condition, the length of the Viscose Staple Fibre can be 2 to 6 mm longer (the ideal) than the staple of carded cotton and 6-8 mm longer than that of combed cotton.

Wider differences do not mean any further improvement but rather decrease uniformity and thus a deterioration of yarn quality, depending on technological conditions and the yarn quality, depending on technological conditions and the yarn number to be spun. Of course it will also depend on the type of the drafting system used in the roving machine and on the ring spinning machine.
The quality of blend also depends whether the titres of the two components match. A micronair value of cotton of 3.6 corresponds to a fibre titre of viscose fibre of 1.27 denier, and a micronair value of 4.2 to a fibre titre of 1.5 denier. These values are obtained by the approximation formula:

\[
\text{TITRE} = \frac{9 \times \text{micronair figure}}{25.4}
\]

\[
dtex = \text{gram/denier} \times \frac{0.9}{0.9}
\]

Of course viscose staple fibre producers are for technical and economic reasons not in a position to produce every titre that corresponds to a determined micronair value. However the range to types and titres is sufficiently wide to meet all requirements.

The usual blends between Viscose Staple Fibre and Cotton are: 10/90, 20/80, 50/50, 75/25. The choice between a bright or a dull fibre adds further possibilities of affecting the product appearance, with carded cotton for examples, you will get a quality similar to that a semi combed cotton, or if combed cotton is used a product of even higher quality.

### 3.2. CARES FOR EQUIPMENT AND OPERATION

**3.2.1. TEMPERATURE AND HUMIDITY**

Satisfactory results will be obtained, if the Rel. Humidity in re-spinning process is made slightly higher than for cotton. Rel.Humidity desirable is above 65 %, however, based on mills experiences, machine condition and the raw material used, the perfect room condition can be obtained with several trials.

**3.2.2. OPENING AND SCUTCHING**

The processing of viscose staple fibre and cotton should be separate and blending will not take place before Drawing Frame. The processing of rayon up to lap form as it was discussed in section 2.3.3. and the arrangement for opening cotton should be suitable for the type of cotton being processed.

**3.2.3. CARDING**

A particular carding should be provided for each processing cotton and rayon for operating method of rayon as described in 2.3.4. and for cotton as its and necessary according to the cotton process and cotton grade.

The sliver weight should be determined in such a way depend upon the blending ratio, the control of sliver weight of each process is very important to maintain the accurate blending ratio. Put the marking or identification on each material to avoid any undesirable mixing in the next stage.
3.2.4. DRAWING FRAME

(a). Two passage drawing is generally practice, even though, it would be advisable to use more than the usually, in order to achieve a really hogenous blend, this will rarely be feasible. In this instance, every spinner will have to decide for himself to which extent he can manage with available possibilities, as this is also a matter of cost.

If high requirements are to be met by dye ability of the product three drawing passages will be required with blending taking place at first passage. By experience it can however, be said that two drawing passages, are quite sufficient for normal requirement.

As mentioned before that it is advisable to mark the entry points of each fibre components at first drawing or at the one where blending takes place, so that always the same blending effect is achieved. The proportionally smaller component should enter in the middle, carelessness in this respect especially, in case of blends between fibre components of widely lead to unpleasant surprise.

According to the existing doubling possibilities on the drawing unit, different blends are possible (e.g. 16/84, 33/67, 50/50 or 12/88, 24/76% etc). Moreover, the card sliver number can be maintained different, so as to get wider range possibilities.

In which way the spinning of cotton is improved by blending with a Viscose Staple fibre is shown in the staple diagram in fig.7z – 7e. They clearly illustrate the advantage resulting from blending a man-made fibre to a natural fibre.

The improvement of the fibre staple, of course, involves a number of other advantages, which are also shown in diagrams for better understanding. Thus, with increasing percentage of viscose staple fibre, above all, the yarn uniformity (uster percentage fig.11), the tensile strength of the yarn (P/tex), especially if high strength Viscose Staple Fibre like High Wet Modulus fibres or polynosic fibre, is used, and also uster value of the roving (fig.10) are improved and the level of required roving twist alters (fig.9). All these factors apart from a better yarn quality mean a considerable increase in production.

(b). ROLLER GAUGE
Roller gauge should be determine based on the fibre length of rayon fibre (see spinning 100% rayon), if Rayon content in the mixing is more than 40%.
(c). **THE SLIVER ARRANGEMENT**

The recommended arrangement of sliver at time of blending is as shown below in which SPV fibre and cotton are placed alternatively (fig.12a), if the rayon sliver found to become irregular, placed cotton on both edge (fig.12b).

![Fig. No. 12 Fibres arrangement on first stage of Draw Frame](image)

Note: Cotton ☒ Rayon ☐

3.2.5 **SPEED FRAME (ROVING)**

For working Viscose Staple Fibre blend with cotton the drafting system of 4 over 4 is satisfactory but, however, using of double apron type is recommended which will provide higher performance.

(a). The twist of roving should be slightly lower than for 100% cotton although it is depend upon the drafting zone condition in ring frame, blending ratios of Cotton and Viscose Staple Fibre. Figure no.9, show the chart of roving twist for various blending ratios.
(b). Roller gauge should be determined similar to principle in draw-frame.
(c). Cares in roving, is true, the same is in spinning 100% rayon.

3.2.5. **SPINNING**

(a). The twist multiplier of viscose blend with cotton can be lower than for 100% cotton, however, this also depend upon blending ratio as mentioned before.

(b). The same principle of roller gauging is also applied in ring frame, one to be consider is the drafting system and drafting condition in ring spinning
(c). YARN COUNT (Ne)
One factor that must not be overlooked when blending Viscose Staple Fibre with Cotton is the thread volume of such blended yarn. The higher the proportion of viscose staple fibre, the less bulky i.e. smoother will the yarn be, therefore, one will have to choose the yarn number and fabric setting accordingly, especially, if one wants to obtain a product that is equal to cotton fabric.

4. SPINNING OF POLYESTER – RAYON BLENDS

4.1. RAW MATERIAL SELECTION
In general Polyester Fibre has high static charge and low hygroscopicity, better elastic property, friction resistant and higher elongation and as mentioned before that Rayon Staple Fibre has opposite properties, therefore, blending between the two fibres will be given better spinnability and performance on cotton spinning system.

<table>
<thead>
<tr>
<th>PROPERTIES COMPARISON BETWEEN POLYESTER – RAYON</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specific gravity</td>
</tr>
<tr>
<td>Tenacity (dry)</td>
</tr>
<tr>
<td>Elongation (dry)</td>
</tr>
<tr>
<td>Moisture regain</td>
</tr>
</tbody>
</table>

4.1.1. SELECTION OF RAYON FIBRE
The same as described in spinning of pure Rayon are applied.

4.1.2. SELECTION OF POLYESTER FIBRE
The type of Polyester to be chosen for blending with Rayon staple is better to follow the recommendation of polyester fibre manufacturer, however, the important points are the fineness and the fibre length of polyester must be properly selected depending upon the fineness of rayon staple fibre and also the yarn count and hand of the resulting blended yarn or fabric to be produce. The same quotations as the basic guide for selecting rayon fibre are also applied for selecting the polyester fibre.

4.1.3. BLENDING
(a). BLENDING SYSTEM
It is recommended (from the technological point of view and because of the different fibre properties) to blend in the fibre stage, i.e. in the flock or in the stock or before card, either:
- Sandwich and topping system
- Blender with automatic weighing pans
- Blending on the 1st Draw Frame stage also is not a bad decision, it is depend upon the machine condition
(b). TINTING
Identification method in the spinning process for various materials generally taken as follows:

- Identification by color of cans and bobbins
- Separation based on “one product on one mill principle”
- Tinted material

Tinting is the easiest and most convenient way among the above method but it is not recommended because it may sometimes cause nepes and fluffs and also dyeing problem.

The following pointed are strictly to be followed if “tinting method” is unavoidable:

- Tinting should be applied on polyester part because the drying of polyester is short, dyeing affinity is comparatively low and easy to be stripped in finishing process, it will contrary if tinting applied on rayon staple fibre since it will become the main causes of generating nepes and fluffs due to entangle fibre, processing problem in dyeing.
- Use spray gun and not brushes
- Tinting solution must be evenly sprayed on four sides of the bales after unpacked and must be left as it is for at least 24 hours.
- The concentration of tinting solution is to be around 0.1% and be applied around 0.00% of weight of fibre
- The tinting agent or dyestuff should be chosen as recommended by polyester manufacturer.

4.2. CARES FOR SPINNING EQUIPMENT

Conventional spinning machine can be used: usually the subsequent process flow is the same as with cotton, if the blends between polyester and rayon staple fibre are in the opening process then two passage of draw-frame are required:

The scheme of the process will be:

```
OPENING  ➔ CARDING  ➔ DRAWING I
(Blending)

RING SPINNING  ←— ROVING ←— DRAWING II
```

Now it is available the auto-matic weighing apparatus to blend the fibre directly in Blow-room stage which can be adjusted according to the requirement.
4.2.1. OPENING AND SCUTCHING

(a). Man-made fibre includes rayon and polyester generally does not contain any foreign matters, therefore it does not required cleaning.

As describe in opening of 100% rayon viscose that excessive beating will cause the fibre damage it is also applied for rayon staple fibre blend with polyester.

As mentioned at the beginning that due to the fibre characteristic, the synthetic fibre, as rule, requires a higher callender roller load to produce well-unwinding of the laps and not too bulky laps.

In order not to damage the added viscose staple fibre, the callender roller load must be reduced as far as possible.

(b). USE OF RECOVERED FIBRES

The same as in spinning of pure rayon that the recovered fibres usually not to be mixed with normal fibre, in case due to some other factors, only certain percentage to be added evenly, to maximum 5% of the total mixing.

The guides of using recovered waste are as follows:

<table>
<thead>
<tr>
<th>Waste Type</th>
<th>Percentage Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lap waste</td>
<td>Not more than 1.5%</td>
</tr>
<tr>
<td>Sliver waste</td>
<td>Not more than 1.5%</td>
</tr>
<tr>
<td>Pneumafil waste</td>
<td>Not more than 5%</td>
</tr>
<tr>
<td>Roving waste</td>
<td>From input quantity</td>
</tr>
<tr>
<td>Flat strip (see notes)</td>
<td>Not more than 5% from input quantity</td>
</tr>
</tbody>
</table>

Notes:
- As far as possible avoid using of flat strip or roving waste, since it may contain of short, entangle fibre which will generate higher nep in the yarn.
- Use pneumafil waste only after removing yarn waste and entangle fibre.
- It is advisable that the recovered fibre only to be used for produce the lower grade/count of yarn.
4.2.2. CARDING

(a). Conventional card, flat card or high production card can be used and will give satisfactory result. As had been compare on 4.1.2. that polyester fibre has a stronger tendency than rayon to stick to the card clothing due to static electricity, therefore use of special methalic card clothing for man-made fibre is strongly recommended.

(b). The following table is shown an example of special card clothing for synthetic fibre:

<table>
<thead>
<tr>
<th></th>
<th>Cylinder</th>
<th>Doffer</th>
<th>Licker-in</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of teeth/in</td>
<td>17</td>
<td>15</td>
<td>4.5</td>
</tr>
<tr>
<td>Number of points/in²</td>
<td>538</td>
<td>400</td>
<td>-</td>
</tr>
<tr>
<td>Working angle</td>
<td>77</td>
<td>70</td>
<td>85</td>
</tr>
<tr>
<td>Back angle</td>
<td>37</td>
<td>52</td>
<td>-</td>
</tr>
<tr>
<td>Height (A)</td>
<td>3.0</td>
<td>4.3</td>
<td>5.6</td>
</tr>
<tr>
<td>Height of tooth tip (B)</td>
<td>0.8</td>
<td>2.5</td>
<td>3.4</td>
</tr>
<tr>
<td>Width of tooth tip (C)</td>
<td>0.1</td>
<td>0.15</td>
<td>-</td>
</tr>
<tr>
<td>Thickness of tooth tip (D)</td>
<td>0.15</td>
<td>0.20</td>
<td>-</td>
</tr>
<tr>
<td>Thickness of rib (E)</td>
<td>0.85</td>
<td>0.75</td>
<td>-</td>
</tr>
<tr>
<td>Thickness of tooth (F)</td>
<td>0.4</td>
<td>0.50</td>
<td>-</td>
</tr>
</tbody>
</table>

(c). The following points should be well considered when running the High Production Card.
- Reducing the running speed.
- Taker in Rpm 600 – 700
- Cylinder Rpm 260 – 290
- Doffer speed 25 - 40
- Fix adequate period of grinding of wire fillets.
- The fibres should have sufficient opening in Blow room, poor opening degree of fed laps will increase the number of neps.
- In case suspect that rayon part has poor opening apply pre-opening before mixed with polyester.
4.2.3. **DRAWING – FRAME**
The same types of Draw-Frame which are used for rayon cotton blend. Can also be used for rayon blend with polyester.

(a). **ROLLER GAUGE**
The roller gauge should be determined according to fibre length to be processed and recommendation from machine manufacturer and mill experiences are to be followed.

(b). **ROLLER WEIGHT**
Since polyester fibre have a higher friction resistance, roller weight must be increased to get the perfect draft.

(c). **RUBBER COTS**
It is recommended to use of anti-static or static-free synthetic rubber cots and use of anti-static film coating or varnishing-agent on the cots is also advisable.
Usually Hucko-lak black or green use as a varnishing agent, which is applied after cot Buffing.

(d). **BAD COILING**
The irregular form coiling is affecting the sliver evenness, it is happened usually because of:

- Damage condensor or unsuitable condensor
- Dirty or rough coiler tube
- Dirty or rough tuber wheel
- Damage can
- Unsuitable can springs
- Too much quantity of sliver in the can

(e). **IDENTIFICATION**
Make sure that the material are easily identified to avoid the accidental mixture by operators. Put a clear marking on every type of materials.

4.2.4. **SPEED-FRAME (ROVING)**
The ordinary speed frame can be used for processing polyester/rayon blend and the following points are to be taken care off:

(a). **ROLLER GAUGE AND ROLLER**
As a rule, that roller gauge will depend upon the fibre length used or as epr recommendation of fibre manufacturer, the heavier roller weight as in Draw-Frame are to be set and use of static-free synthetic rubber cots is also recommended.
(b). **ROVING TWIST**
Roving twist should be lower than for cotton or even lower than for rayon/cotton blend, the determination is also depend on fibre length, fineness, drafting condition in ring spinning etc.

(c). **SYSTEM OF SLIVER SUPPLY**
To avoid too many sliver changes due to empty can in different places within one speed frame and also to avoid all cans becoming empty, which will deteriorate the sliver quality, it is recommended to supply sliver as follow.

Divide the spindles of a speed-frame into four block or three block with difference period of the supplied sliver quantity in the cans between those blocks.

1\(^{st}\) block is supplied with full quantity  
2\(^{nd}\) block is supplied with \(\frac{3}{4}\) of full quantity  
3\(^{rd}\) block is supplied with \(\frac{1}{2}\) of full quantity  
4\(^{th}\) block is supplied with \(\frac{1}{4}\) of full quantity

When the cans in fourth block are empty, the block should be replace only with full quantity, in the meantime other block have already reduced by \(\frac{1}{4}\) of quantity, and this sequence will continues.

(d). **CLEANING OF THE FLYER**
All fibres or flies adhered to the flyer must be removed 2 times per doffing cycle, otherwise this fibres will degrade the roving evenness and generate the slubs it is necessary to clean the flyer fingers (where the roving pass) by organic solvent periodically, every month is advisable.

(e). **IDENTIFICATION**
As in draw-frame, make sure that all roving bobbins are identified.

4.2.5. **SPINNING**

Ordinary ring spinning frame can be used without any major changes, the following are points for consideration in spinning process.

(a). **DRAFT**
The break draft between 1.2 to 1.38 and the total draft less than 30 is desirable, to get the good quality, of course, higher total draft may be applied depend upon the drafting system and machine condition and also yarn quality to be achieved.

(b). **ROLLER GAUGE AND ROLLER WEIGHT**
The same principle as in speed frame is advised for ring spinning frame.
(c) **TWIST**

Generally yarn twist is lower than either cotton or rayon/cotton, however it should be finally determined depending upon the requirements or yarn characteristic or fabric to be.

(d) **FINE ADJUSTMENT OF THE PARTS**

It is necessary to set carefully the following parts.
- Centre line of the ring spindle, part-lappets eye-anti ballooning rings, should be straight on a centre.
- Ring and traveller clearer to be set perfectly.
- Top roller should be trouble free
- Spindle tape should be in good condition and enough tension.

(e) **TRAVELLER**

Traveller is to be chosen as recommended by the maker.

(f) **HANDLING OF MATERIAL**

The implement of careness in handling is very important to avoid the quality deterioration due to bad handling in ring spinning.

After spinning process they are limitations for improving the yarn faults.

5. **OPEN END SPINNING PROCESS**

The aim of using the open-end spinning are:
1. To short-cut the sequences of spinning process
2. To increase the production per unit machine (the rotor can be speed up to 80,000 even 100,000 rpm)
3. To achieve the maximum advantage from the lower cotton grade, either pure or blend with rayon.

In short that the final aim of using the open-end spinning is to reduce the production cost by increasing quantity of the product.

As we are aware that up to Draw-Frame stage the normal equipment on cotton spinning system can be used to process material to be fed to open-end spinning, two passage or more of Draw-frame is advisable to achieve the smooth operational and better yarn quality.

It was mentioned before that in case of blending rayon with cotton, the fibre should be processed separately and blend only after carding process.

South Pacific Viscose staple fibre can be processed pure and in blends with cotton or polyester fibre without problem on any well-know open-end spinning machines.

The table in 7.4.1 contains all important data on machine setting, rotor speed and yarn values. The normal South Pacific Viscose fibre has no special fibre finish for open-end spinning and therefore, a spinner who uses both spinning techniques will only need one type of South
Pacific Viscose fibre to be used. The dulling agent incorporated in the dull fibre attack the spinning equipment and causes their wear.

In fibre blends between SPV staple fibre dull and cotton, as they are sometimes ask for fashionable goods the cotton reduces the wear of the spinning equipment, still we would recommend to use only the bright type for such fibre blends on open-spinning machines.

**EXAMPLE OF MATERIAL SELECTION FOR RAYON/COTTON BLEND**

On a study by Rieter using open-end spinning type M1/l it was proved that a lower grade cotton owing a wide variation in short fibre and fineness maybe spun satisfactorily by adding a certain percentage of Lenzing Modal Fibre (where the Technical Know How of South Pacific Viscose taken from).

In **Fig. 13a and 13b** clearly shows the datas regarding the above possibilities.
6. THE COMMON FAULT & CORRECTION

6.1. UNEVENNESS OF YARN

6.1.1. SHORTTERM IRREGULARITY OF YARN USUALLY DUE TO:
   a. Damage or eccentricity of top or bottom roller or improper running rollers.
   b. Faulty seam of apron or clogging of apron inside.
   c. Faulty of gearing i.e. wear, eccentricity or faulty intermeshing of gear.
   d. Roughed apron elongated on one side or improper running apron.
   e. Improper roller setting in ring-frame draft zone.
   f. Excessive total draft
   g. Wrong selection of fibre characteristics i.e. fineness, fibre length and coefficient of friction in relation with yarn count.

6.1.2. LONGTERM IRREGULARITY
   a. Improper setting of back-zone drafting or break draft
   b. Less roller weight
   c. Inadequate twist factor of rovings
   d. Unevenness material in fore spinning (rovings or sliver) includes variation in weight of roving or sliver in the back process.
   e. Excessive draft in various draft-zone
   f. Bobbin rovings are not rotating freely

6.1.3. CORRECTIONS
   a. Maintain properly the roller part and apron as explain earlier.
   b. Check all gears regularly
   c. Check the fore spinning quality regularly and when ever necessary
   d. Check all operating condition i.e.: spinning parameter, mechanical condition, raw material (etc)
   e. Increase the roller weight when ever necessary
   f. Periodic cleaning of ring-frame is to be carried out daily.

6.2. YARN COUNT VARIATION

6.2.1. The following items usually affecting the yarn count variation.
   a. Improper back-draft zone setting or break draft
   b. Wrong selection of roving twist
   c. Insufficient roller weight or improper setting of some arm weight
   d. Variation roving weight within or between the bobbin or between the slivers.
   e. Large variation in the moisture regain inherent to raw material
   f. Damage/grooved rubber cots or aprons
   g. Material lapped on back roll
6.2.2. CORRECTIONS

a. Re-set the back draft zone setting or apply a proper break draft
b. Set-right the roving twist
c. Review the roller weight or re-set the arm properly
d. Minimize the variation in the back process, check the draw-frame staop-motion.
e. Maintain the cot and apron and replace them if necessary.

6.3. FLUFFY AND FUZZY YARN

6.3.1. Due to mechanical or machine parts

a. Fluffy slivers because of defective fleece angle
b. Defective collector of roving frames or inadequate shape and width of condensor
c. Improper roving tension
d. Entanglement of slivers behind the speed frame (roving frame)
e. Friction roving with rough flyers or fingers pressure.
f. Unsuitable draft system
g. Lapping tendency owing to inferior surface condition of rollers
h. Wrong selection of traveller
i. Vibration of spindle, spindles are not gauges properly.
j. Roughened top of the spinning tube
k. Defective or wedging of ring or traveller
l. Collision with ring separators

6.3.2. DUE TO FIBRE CHARACTERISTICS

a. Shorter fibre length or coarser fibre denier
b. Abrasion resistance too high
c. Higher static electricity generation
d. High percentage of fibre rupture in card or due to excessive beating.

6.3.3. CORRECTIONS

a. Try to reduce fluff in fore spinning department
b. Set-right the working condition in fore spinning department
c. Check the drafting-zone, and implement the best maintaining of top rollers and aprons
d. Select the right traveller
e. Change the machine’s parts if necessary
f. Select the right fibre to aim the product
g. Select the right card metallic wire
h. Select reduce the beater rpm
6.4. LOOSE AND OVER TWIST

6.4.1. LOOSE TWIST (Yarn have lower twist than specified)

Suspensions:

a. Damage spindles and vibrating spindles
b. Loose ring tube
c. Spindle slipped due to:
   - Loose spindle tapes
   - Blocked of insert bearing
   - Damage of insert bearing
   - Stiff and longer tapes joint
   - Disengagement of top frame spindle wharve
d. Higher yarn count due to:
   - Less weight of roving
   - Disturbance on ring frame creels (bobbin hunger)
   - Damage of bearing on top roller.

6.4.2. CORRECTION OF LOOSE TWIST

a. Perfectly maintain the twisting mechanism and other equipment in ring frame especially
   - Creel parts
   - Drafting zone
   - Maintaining of spindles
   - Bearings concerned with twisting equipment
b. Check regularly the spindle tape especially during regular preventive maintenance for the correct condition.
c. Reduce uneven grain of roving by mean of well-plan of quality control system in fore spinning, also regularly check whether the controlling are properly done by laboratory operators.

6.4.3. OVER TWIST YARN (higher than twist than the specified)

a. Coarser yarn count due to heavier of roving weight because of:
   - Drafting failure
   - Overlap or excessive piecing of sliver or roving
   - Double roving, a broken roving entering the adjacent spindle in speed frame (roving)
   - Entangle sliver behind the speed frame (on the creels)

b. Faulty operation in ring frame:
   - Improper piecing of roving during change
   - A miss roving from traverse guide
   - Lifter top roller due to mishandling or back bottom roller lapping
   - Incorrect break-draft
c. Faulty ring frame mechanism:
   - Disturbing of front top roll rotation due to lack of greasing
   - Incorrect of drafting weight especially back roll
   - Sagging of roving due to incorrect gauging
   - Fixing a wrong twist change gear

6.4.4. CORRECTIONS FOR OVERTWIST
a. - Well quality control plan to be implemented
   - Make sure that machine operators and laboratory operators are doing the satisfactory job accordingly to avoid the trouble or thicker roving.
   - Improve the supervisory system, improve the basis knowledge of the operator
   - Motivate the quality consciousness

b. - Maintain the roller part as describe earlier
   - Make sure that drafting-zones are always cleaned
   - Check the yarn count or twist especially after regular maintenance

6.5. NEPS

6.5.1. The main causes of nep generation in synthetics processing on cotton system are mainly as follows:
   a. Inadequate use of recovered fibres (see using of recovered fibres)
   b. The fibre denier is too fine
   c. Over-beating, poor opening degree and entangle fibre in blow-room machinery or fibre breakage caused by poor opening characteristics especially in case of insufficient fibre strength
   d. Excessive lap or sliver weight or too large variation or lap weight
   e. Over action in carding process
   f. Fibres wrapping in taker-in cylinder of carding
   g. Rubbing of cylinder against flat
   h. Wedging of yarn between ring and traveller
   i. Cracks of ring or traveller-damage/burnt
   j. In sufficient cleaning of machines and rooms.

6.5.2. CORRECTIONS
   a. Mixed recovered fibre evenly max 5% of the total mixing quantity
   b. Check the process condition from blow-room to draw-frame and studied the nep generation in each stage of beating point and card action.
   c. Reduce the revolution of parts in card to certain extend.
   d. Fix the adequate grinding schedule especially fillets wire
   e. In case of poor opening of rayon part, apply pre opening
   f. Prevent the ring-frame rough handling and change the traveller accordingly.
6.6. SLUBS

6.6.1. EXTREMELY THICK PART OF YARN, CAUSES BY
   a. Insufficient of parallelizing the fibres in slivers or rovings.
   b. Extremely unevenness of sliver or roving due to faulty roller revolution or toller
damage
   c. Excessive or improper piecing of roving
   d. Tight aprons-causing faulty revolution
   e. Clogging of flye waste in top apron as well as bottom
   f. Lapping on top/bottom roller
   g. Improper of machines cleaning
   h. Entry by dropping of clearer waste
   i. Entry by flies or arrested fibre during roving breakages

6.6.2. CORRECTIONS
   a. Review the roller setting and weight of drafting arrangement in Draw-frame and
      Roving-frame
   b. Maintain apron and roller as describe earlier
   c. Train the operator regularly to improve their skill and ability
   d. Clean the machine and rooms properly

6.6.3. SLUBS FORMED BY TOO LARGE OR TOO LONG JOINT IN THE YARN
       CAUSES BY
       a. Wrong piecing and improper yarn cutting
       b. Piecing from the back of front top roller
       c. Front top roller is not cleaned properly before piecing.
       d. Inclusion into yarn at the time of piecing due to fibre chocked on the flute of
          pneumafil tube.

6.6.4. CORRECTIONS
   a. Operator should be trained to piece-up the yarn properly.
   b. Maintain the machine cleanliness
   c. Maintain the pneumafil tube to avoid the arrested fibre by insufficeint suction or
      rough surface.
1. Properties and spinabilities
   1.1. Physical fibre properties
      1.1.1. Hygroscopic properties
      1.1.2. Static charge
      1.1.3. Friction
      1.1.4. Crimp
   1.2. Spinabilities of fibre

2. Spinning of 100% Rayon
   2.1. Raw Material Selection
      2.1.1. Types of material
      2.1.2. Fineness and fibre length
      2.1.3. Spinabilities
   2.2. Spinning equipment
      2.2.1. Opening
      2.2.2. Carding
      2.2.3. Draw-frame
      2.2.4. Speed frame (Roving)
      2.2.5. Ring-Frame
   2.3. Cares for spinning operations
      2.3.1. General
      2.3.2. Raw material
   2.4. Spinning Operation guide
      2.4.1. Blow-room
      2.4.2. Carding
      2.4.3. Draw-frame
      2.4.4. Speed frame (Roving)
      2.4.5. Ring Frame
   2.5. Precaution and others
      2.5.1. Lapping causes & remedy
      2.5.2. Maintain of cots & approns
      2.5.3. Treatment of cots & approns

3. Blending with other fibres:
   3.1. Cotton/Rayon blends
      3.1.1. Selection of Raw material
   3.2. Cares for operation & equipment
      3.2.1. Temperature and humidity
      3.2.2. Opening
      3.2.3. Carding
      3.2.4. Draw frame
      3.2.5. Speed frame (roving)
      3.2.6. Ring spinning

4. Blending rayon with polyester
4.1 Raw Material selection
   4.1.1 Selection of rayon fibre
   4.1.2 Selection of polyester fibre
   4.1.3 Blending
4.2 Care of spinning equipment
   4.2.1 Opening
   4.2.2 Carding
   4.2.3 Draw-frame
   4.2.4 Speed frame (roving)
   4.2.5 Ring frame

5. Open-end spinning process.

6. Common fault and correction
   6.1 Unevenness
      6.1.1 Short term irregularity
      6.1.2 Long term irregularity
      6.1.3 Corrections.
   6.2 Yarn count variation
      6.2.1 General
      6.2.2 Correction
   6.3 Fluffy & fuzzy yarn
      6.3.1 Mechanical problem
      6.3.2 Fibre characteristic
      6.3.3 Correction
   6.4 Loose and over twist
      6.4.1 Loose twist
      6.4.2 Correction of loose twist
      6.4.3 Over twist
      6.4.4 Correction of over twist
   6.5 Neps
      6.5.1 General
      6.5.2 Correction
   6.6 Slubs
      6.6.1 Thick part
      6.6.2 Correction
      6.6.3 Joint
      6.6.4 Correction