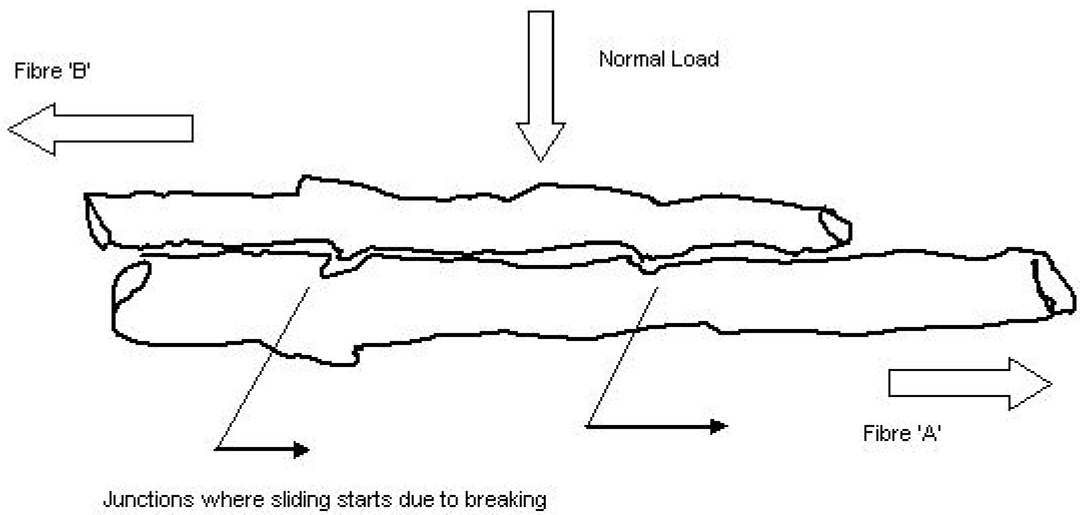
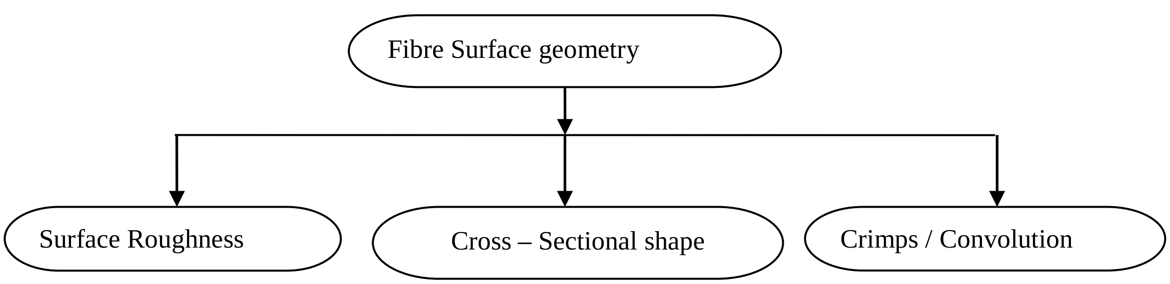
Critical analysis of inter – fiber friction, role of top & bottom aprons , drafting force and effects of process variable's on yarn quality

Effect of Inter-fibre friction:

Fibers are held in yarn by inter-fibre frictional contact.



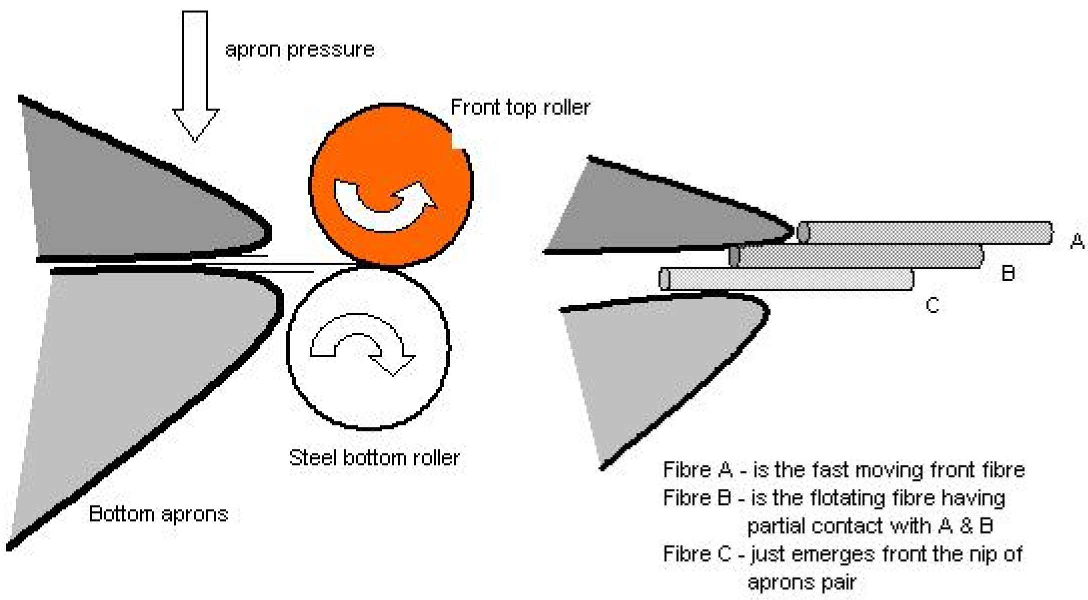
The quality of Force 'F' will depend on both pressure and area of contact.



- Inter fibre frictional forces plays secondary role in preparatory process such as sliver, rove stage and plays important role at final stage.
- Fibre treatment with PEG increases the co-efficient of dynamic friction and decreases the static frictional co-efficient.

Role of aprons:

1. In a R/F drafting system to avoid formation of drafting wave the fibres should accelerate at the same speed of rollers only when they gripped by it.
2. The control over floating fibres is affected by set of aprons.
3. One of the causes of irregularity in the drafted strand is dragging of un-drafted strand into the nip of front roller due to increase in drafting force.
4. It is possible that drafting wave can be avoided if frictional resistance between the fast moving fibre and the floating fibre is maintained less than combined force of frictional resistance between the floating fibre and slow moving back fibre and the frictional resistance between floating fibres & aprons.



Under normal conditions the fast moving fibre A should over come the resistance offered by fibre B which is a floating fibre at the same time fibre B should overcome the frictional resistance offered by fibre C which in turn gripped by the apron pairs .

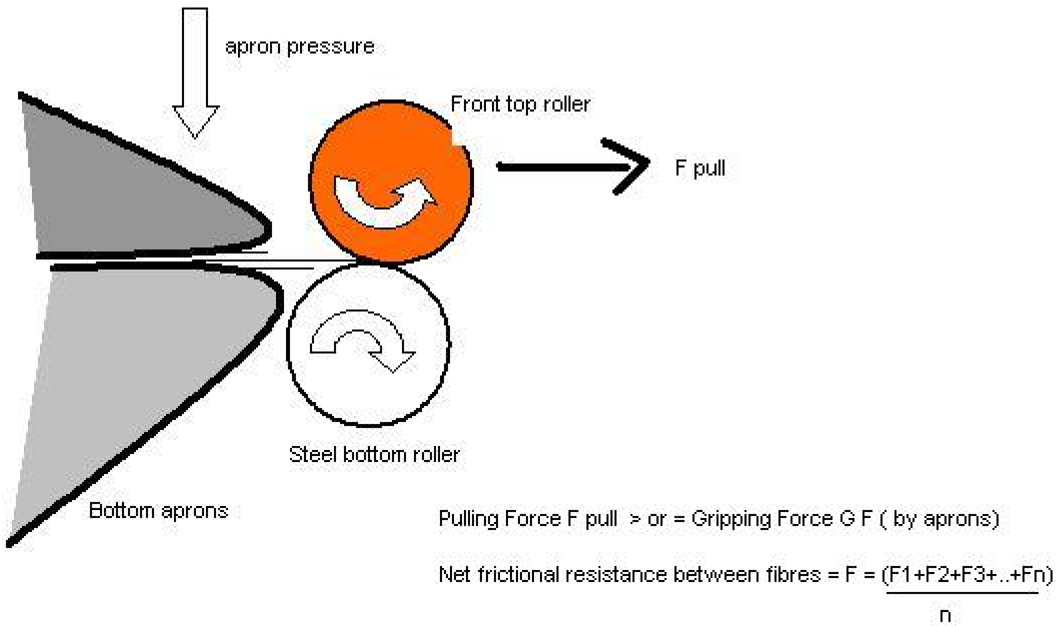
Mathematically,

Force of frictional resistance between ‘A’ & ‘B’ < Force of frictional resistance between ‘B’ & ‘C’ + Force of frictional resistance between ‘c’ & aprons

Force of frictional resistance = FR

$$F_{R\,(A\text{-}B)} < F_{R\,(B\text{-}C)} + F_{R\,(B\text{-}apron)}$$

Let us consider there are ‘n’ no, of fibres at the cross sectional area held together by frictional forces. In order to avoid ‘ roller slippage’ the net pulling force required at the front roller should be greater than the additional of frictional resistance between the group of fibres and the force exerted by aprons over the fibres.



Net frictional resistance between fibres = F_F
Net frictional resistance offered by aprons over fibres = F_A

To avoid roller slippage,

$$F_{pull} > F_F + F_A$$ - To avoid roller slippage

If $$F_{pull} < F_F + F_A$$ - roller slippage will occur

Average roughness (Ra value) of front top roller cot and roller slippage, un-drafted end relationship:

If a spinning cot measures 0.2 µm or 0.3 µm Ra Value it means that the cot surface is very smooth. Mechanically, a surface which is very smooth will offer very low frictional resistance on the fibres. In other words the pulling force ‘F_{pull}’will be reduced significantly which leads to roller slippage and un-drafted strands of fibres and the same time if a strand of fibres offers less resistance to drafting then drafting related faults and long faults may reduce.

R A value of the cot σ Pulling Force offered on the fibre strand

Drafting force:

The force necessary to give rise to the average tension in the moving fibre mass in a drafting zone is referred as "Drafting Force"

Draft, Drafting Speed and Roller setting:

Roller setting σ 1 / drafting force

Drafting force is influenced by the following material parameters;

1. Fibre length
2. Fibre fineness
3. Crimp / Convolution
4. Fibre to fibre friction
5. No. of fibres in the strand
6. Fibre parallelization
7. Packing factor
8. Twist
9. Material irregularity

Mechanical parameters that will influence drafting force are as follows
1) Draft ratio 2) Drafting speed 3) Roller setting

The process of attenuation of linear fibre assembly by roller drafting causes a tension to be generated in the fibres in the drafting zone.

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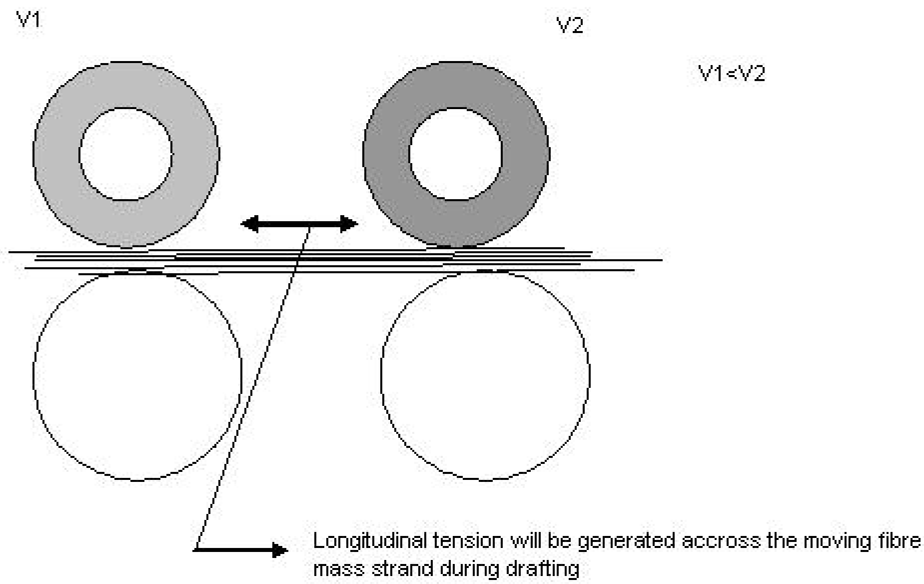

Measurement of drafting force is a useful aid raw material selection , optimization of spray oils used in cotton , optimization of crimp and spin finish level in synthetic fibres.
The frictional force acting on fibre assembly during drafting can be determined experimentally by measuring the total resistance of fibre assembly. The frictional force depends on relative fibre velocities and density distribution.

Fibre length is significantly more correlated with the drafting forces compared to the fibre fineness. Experimentally 1% change in fibre length changes the drafting force by about 5%. It has also been studied that the increase in roving twist causes increase drafting force.

Mathematically,

Drafting Force = D_F
Fibre Friction = F_F
Roving hank = $Rove_H$
Roving Twist multiplier = $Rove_{TM}$
Roller setting = $roll_{set}$ ‘
Drafting speed = $Draft_S$
Draft = D

$D_F \quad \sigma \quad 1 / D$

$D_F \quad \sigma$ Draft s … (initially when draft is very low)

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D_F σ 1 / Draft s (when draft is relatively high)

D_F σ 1 / roll $_{set}$

D_F σ F_F

D_F σ 1 / Rove $_H$

D_F σ Rove $_{TM}$

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