Acid Treatment of Starch

The viscosity of sizing paste influences wet pick-up and resultant add-on %.

The viscosity is influenced by concentration of starch (solid content) and molecular chain length of starch.

To reduce concentration of sizing paste, keeping the solid content same, acid treatment is performed.

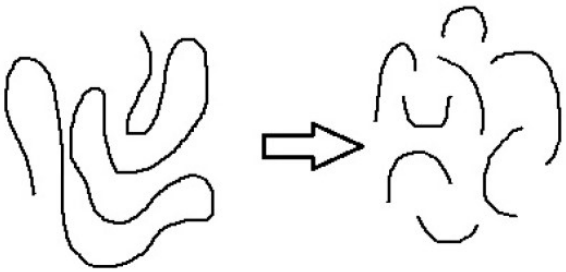
The acid treated starch is often termed as 'thin boiling starch' as it results lower viscosity than the normal starch at a given concentration.

Acid Treatment of Starch

Aqueous solution of starch is treated with hydrochloric acids

The acid cleaves polymer at glycoside linkage and thus length of polymer chain is reduced

Hence, viscosity is reduced and fluidity increased.

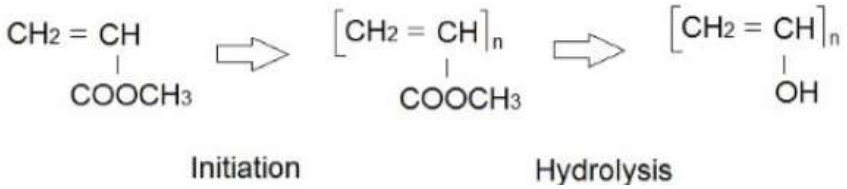


Polyvinyl Alcohol (PVA) size

Polyvinyl alcohol (PVA) is versatile sizing material.

Used for sizing cotton, rayon, polyester and their blends.

Manufactured by polymerizing vinyl acetate monomers and then substituting acetate groups with hydroxyl groups by hydrolysis



Polyvinyl Alcohol (PVA) size

The properties are largely governed by degree of substitution.

If PVA is hydrolyzed to maximum possible extent (>99%), then formation of hydrogen bonding becomes very intense and thus strength of PVA film becomes very high.

But, its solubility in water lowered and desizing becomes difficult

Therefore, super hydrolyzed PVA is generally not preferred for sizing.

Polyvinyl Alcohol (PVA) size

Partially hydrolyzed PVA exhibits lower film strength due to big functional group in the side chain

Advantages are easy separation of yarns after drying and less disruption of size film.

Partially hydrolyzed PVA also shows better adhesion with hydrophobic fibres

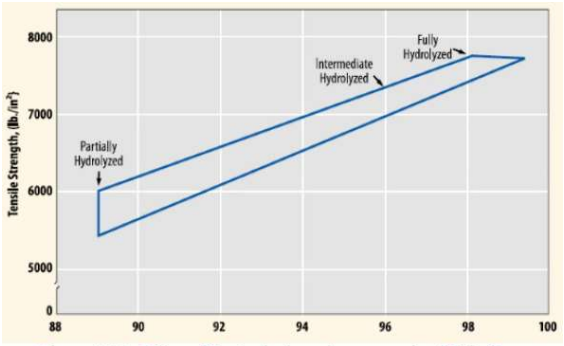


Figure 4.10: Effect of hydrolysis on the strength of PVA film.

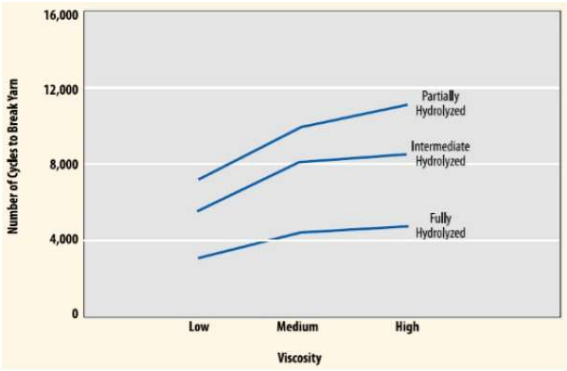
Polyvinyl Alcohol (PVA) size

Partially hydrolyzed PVA exhibits

✓Less shedding or dropping of size

✓Lower yarn hairiness

✓Lower size add-on



Polyvinyl Alcohol (PVA) size

Table presents the degree of hydrolysis and application range for various grades of PVA.

Table 4.4: Degree of hydrolysis in different grades of PVA

PVA grade	Degree of hydrolysis	Application
Super hydrolysed	>99%	Not a preferred material for sizing
Fully hydrolysed	98-99%	100% Cotton
Intermediate hydrolysed	95-98 %	Polyester and other synthetic fibres and blends
Partially hydrolysed	87-90	Polyester and other synthetic fibres and blends

Polyvinyl Alcohol (PVA) size

Typical Recipe of Sizing

Carded cotton yarn

Modified Starch	**: 10.5 % on the weight of water**
PVA	**: 2.86 %**
Acrylic binder (liquid)	**: 6.6 %**
Lubricant	**: 0.7 %.**

Paste viscosity: 6.5±0.2 second, Solid content: 12-13%

Combed cotton yarn

Modified Starch	**: 12.5 % on the weight of water**
PVA	**: 3.0 %**
Acrylic binder (liquid)	**: 6.91 %**
Lubricant	**: 0.87 %.**

Paste viscosity: 6.4±0.2 second, Solid: 12%

Polyester-cotton blended yarn

Modified Starch	**: 13 % on the weight of water**
PVA	**: 3.6 %**
Acrylic binder (liquid)	**: 8.4 %**
Lubricant	**: 0.87 %.**
Antistatic	**: 0.5 kg**

Paste viscosity: 7±0.2 second, Solid: 12-13%

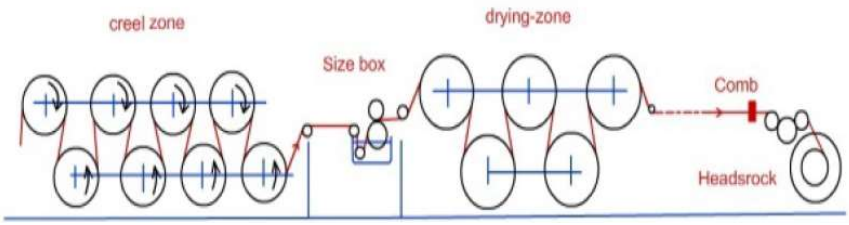
Sizing Machine

Creel zone

Size box zone

Drying zone

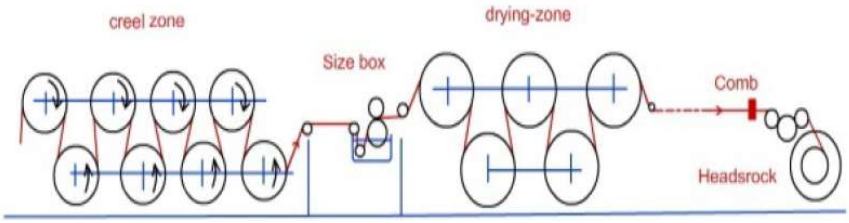
Headstock zone



Creel zone

The creel zone contains large number of warper's beam which can be arranged in different fashion depending on the design of the creel.

Individual warp sheet emerging from warper's beam are merged together to form the final warp sheet which passes through the size box.



Creel zone

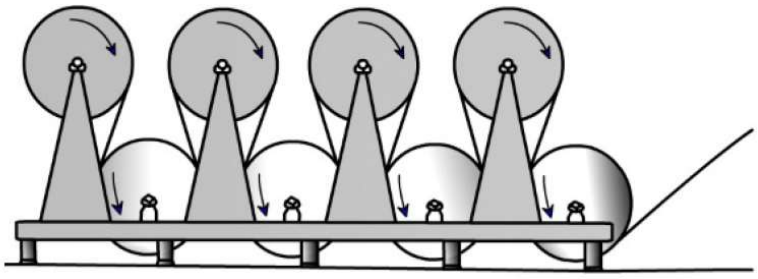
The creel zone of a sizing machine can have following types of design:

- ✓Over and under creel
- ✓Equi-tension creel
- ✓Vertical creel
- ✓Inclined creel

Over and under creel

Warper's beams are arranged in two rows, having different heights, in an alternate manner.

However, the warp sheet coming from rearmost beam experiences more tension and stretch



Over and under creel

The problem is partially mitigated when two creels are used one for each of two size boxes

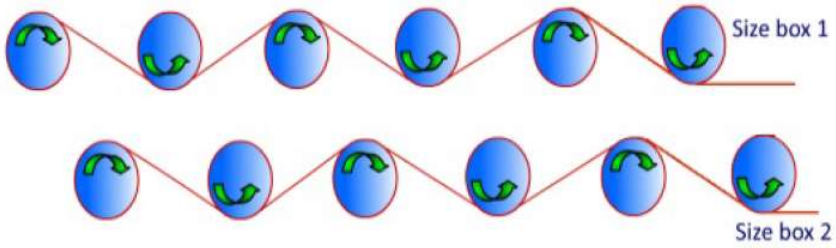


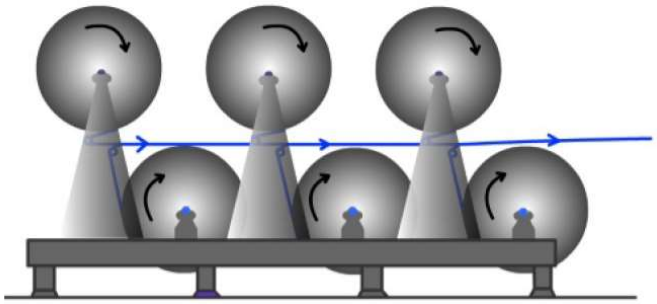
Figure 4.15: Over and under creel for two size boxes

Equi-tension creel

Warp sheet does not move over and under any beam.

One small guide rollers provided with every beam which deflects the warp sheet towards the proper path.

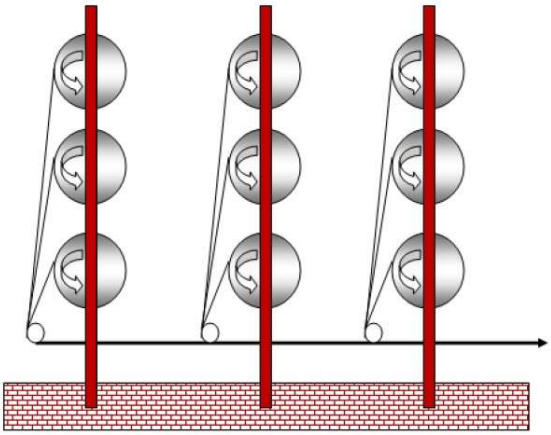
Hence, warp sheets are subjected to equal tension and stretch irrespective of the position of the warper's beam.



Vertical creels

Previous creels require considerable amount of floor space

But vertical creels require less space as beams are stacked vertically

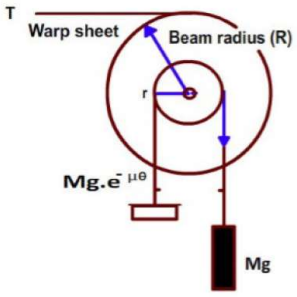


Tension adjustment during sizing

It is very important to maintain adequate and uniform tension in the warp sheet during sizing.

However, as sizing process continues, radius of warper's beam reduces.

Therefore, warp tension maintained by adjusting either dead weight or by controlling pneumatic pressure applied on warper's beam.



Size Box Zone

Warp sheet is immersed into size paste and then squeezed under high pressure to form uniform coating over yarn surface.

The process of immersion is called ‘dip’ and process of squeezing is called ‘nip’.

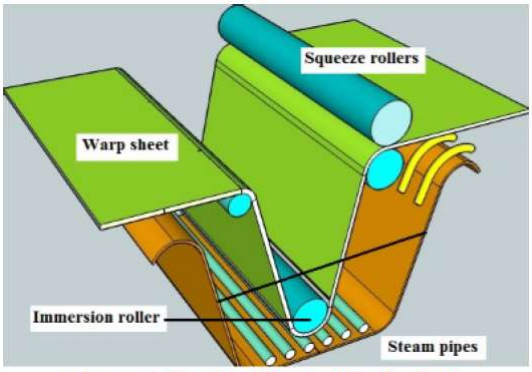


Figure 4.19: One dip one nip size box

Size Box Zone

For filament yarns ‘one dip and one nip’ is preferred where as for spun yarns ‘two dip and two nip’ is advisable.

Two dip and two nip process allows grater time for immersion of yarns within size paste and thus forms more uniform coating of size film.

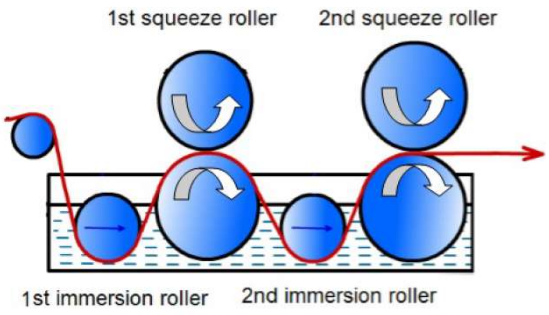


Figure 4.20: Two dip two nip size box

Sizing Parameters: Viscosity of Size Paste

The viscosity of the size paste is influenced by the concentration (solid content) and temperature of size paste.

Higher concentration and lower temperature implies higher viscosity.

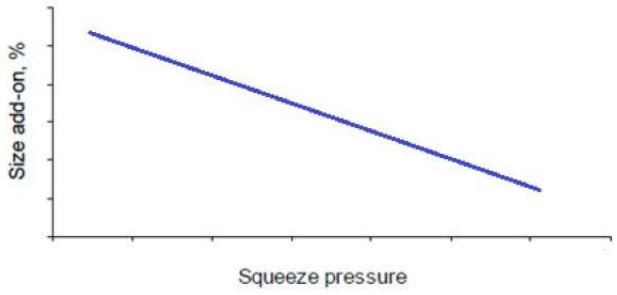
The wet pick-up generally increases with the increase in viscosity.

If more penetration is desired then viscosity should be lowered and vise versa

Sizing Parameters: Squeezing Pressure

The squeeze pressure forces out the excess paste picked up by the warp sheet, distributes the paste uniformly over the yarn surface and causes size penetration within the yarn structure.

Higher squeeze pressure reduces the wet pick-up and add-on%



Sizing Parameters: Hardness of Top Squeeze Roll

The top squeezing roller is having a metallic core part covered with synthetic material.

If the hardness of the top roller is low, then there will be flattening of the roller. Thus the contact area increases which effectively reduces the pressure acting at the nip zone. Therefore, the size pick-up increases.

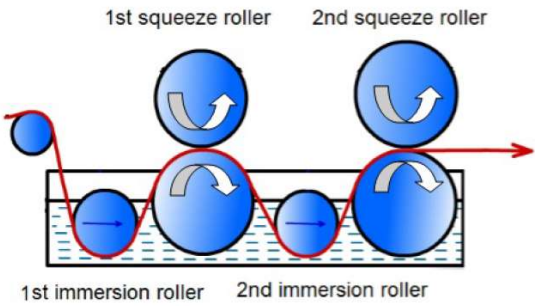
In contrast, harder rollers give sharper nip and lower wet pick-up.

The shore hardness of the top roller is around 45°.

Sizing Parameters:Thickness of Synthetic Rubber on Top Roller

If the thickness of synthetic rubber cover on the top roller is greater, then the extent of flattening is more.

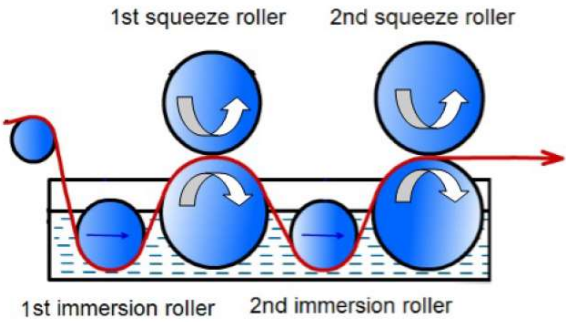
This will reduce the nip pressure and thus the wet pick-up will increase.



Sizing Parameters: Position of Immersion Roller

If the height of immersion roller is lowered then the residence time of the warp sheet within the size paste increases.

This will lead to the increase in wet pick-up



Sizing Parameters: Speed of Sizing

Speed of sizing also influences the wet pick-up by the warp sheet.

Higher speed reduces the residence time of the yarn within the paste which should reduce the wet pickup.

Higher speed reduces the time of squeezing which should increase the wet pick-up.

In modern sizing machine, the practical speed can be around 100 m/min.