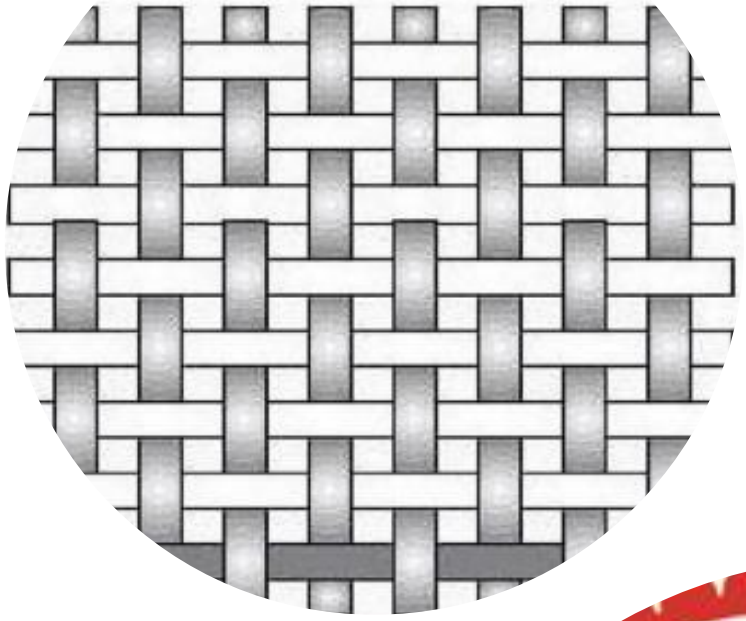
Fabric Manufacturing I (TXL231)



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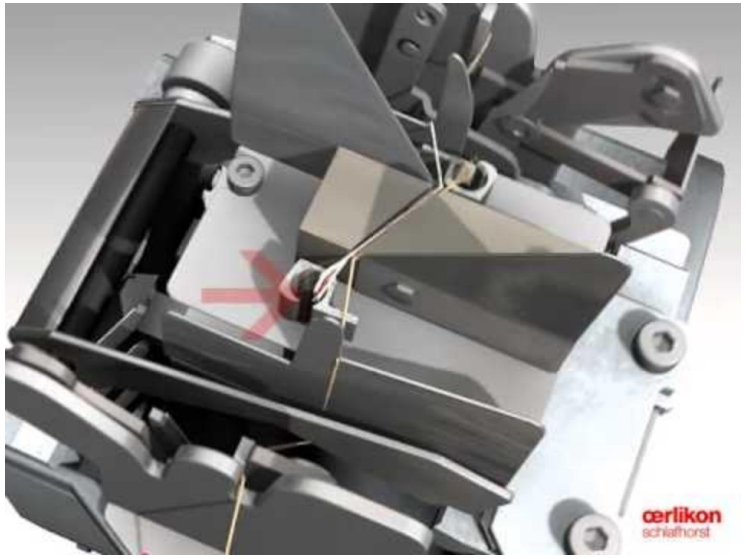
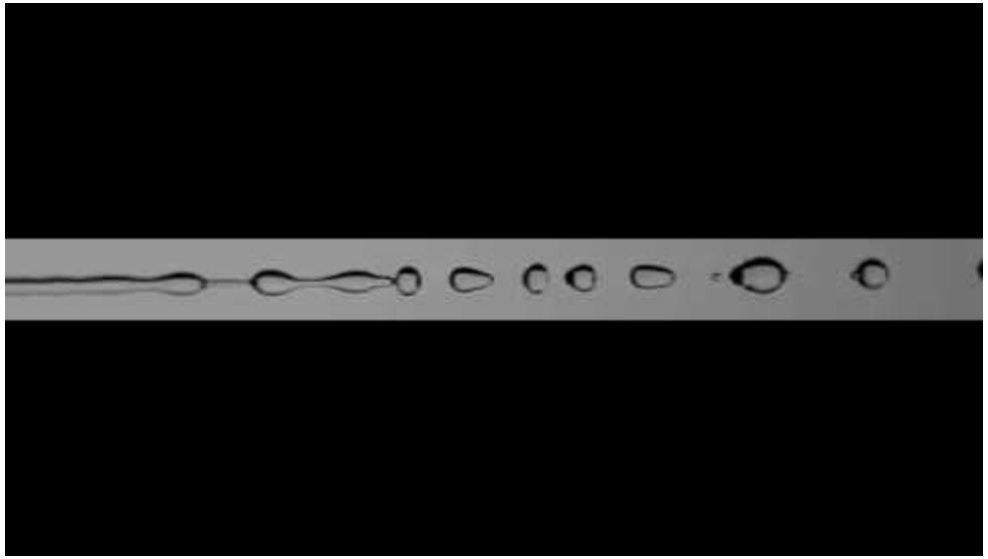


https://www.youtube.com/watch?v=x51KmhTmyRM

Yarn splicing

https://www.youtube.com/watch?v=Fv-2Yl2A_KE

Yarn traverse



https://www.youtube.com/watch?v=X3PdtK5it5o

Capillary instability

https://www.youtube.com/watch?v=e0dJLk3YlFA

Yarn winding

https://www.youtube.com/watch?v=U1u9PM6NOfU

Link to understanding kite flying

Sizing: Recap

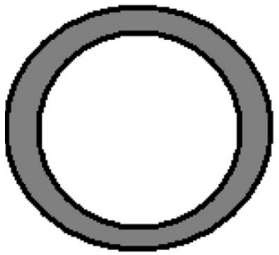
The objective of warp sizing is to improve the weaveability of yarns by applying a uniform coating on the yarn surface so that protruding hairs are laid on the yarn surface

Benefits of Sizing

- It prevents the warp yarn breakage due to abrasion with neighboring yarns or with back rest, heald eye and reed.
- It improves the yarn strength by 10 to 20%, although it is not the primary objective of sizing process.

Sizing materials

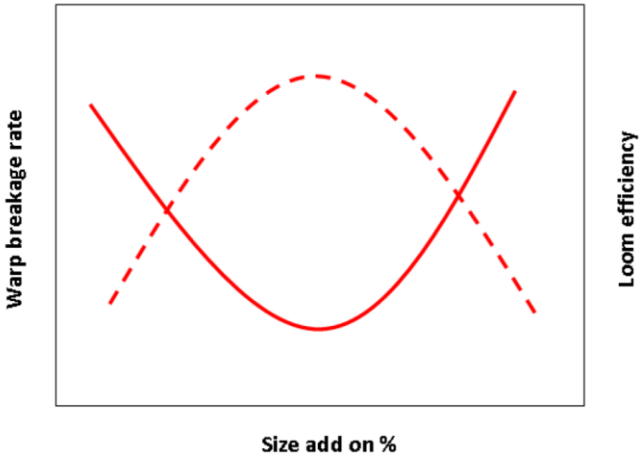
- Starch
- PVA

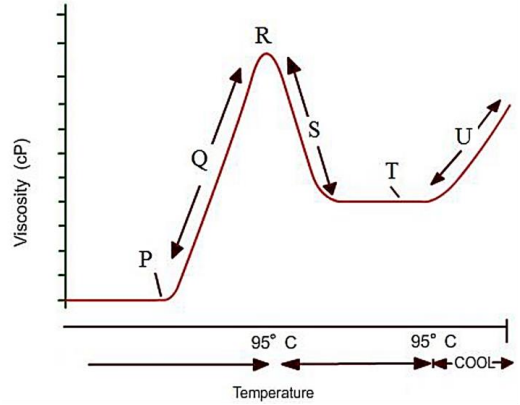


Size coating

size penetration

optimum coating and penetration





P- gelatinization temperature (crystal structure broken ~60 deg C)

Q- Increase in viscosity due to swelling

R- Maximum viscosity (also aided by stirring), starch granules break

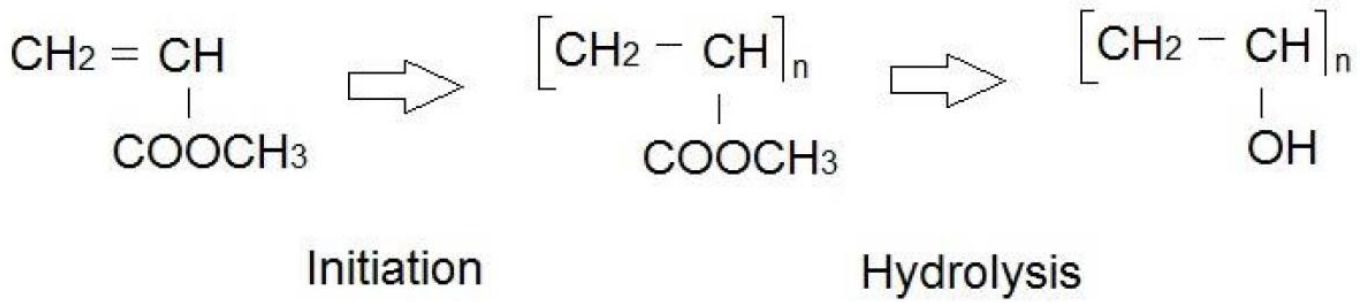
S- The chai molecules of amylose and amylopection come out within the solution causing reduction in viscosity

T- When all the granules have burst, the viscosity stabilizes or levels off

U-When the solution is cooled, the starch gels due to the formation of a rigid interlocked micelle-like structure having hydrogen bonding (ready for coating) (retrogradation of starch)

Sizing: Material-Polyvinyl Alcohol (PVA)

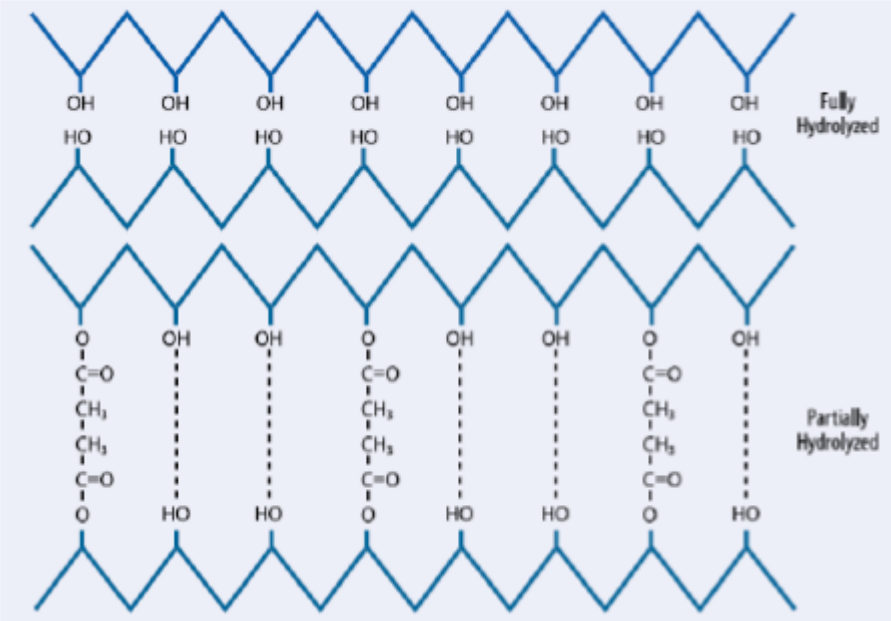
PVA can be used for sizing cotton, rayon, polyester and their blends. It is manufactured by polymerizing vinyl acetate monomers and then substituting the acetate groups with hydroxyl groups by hydrolysis



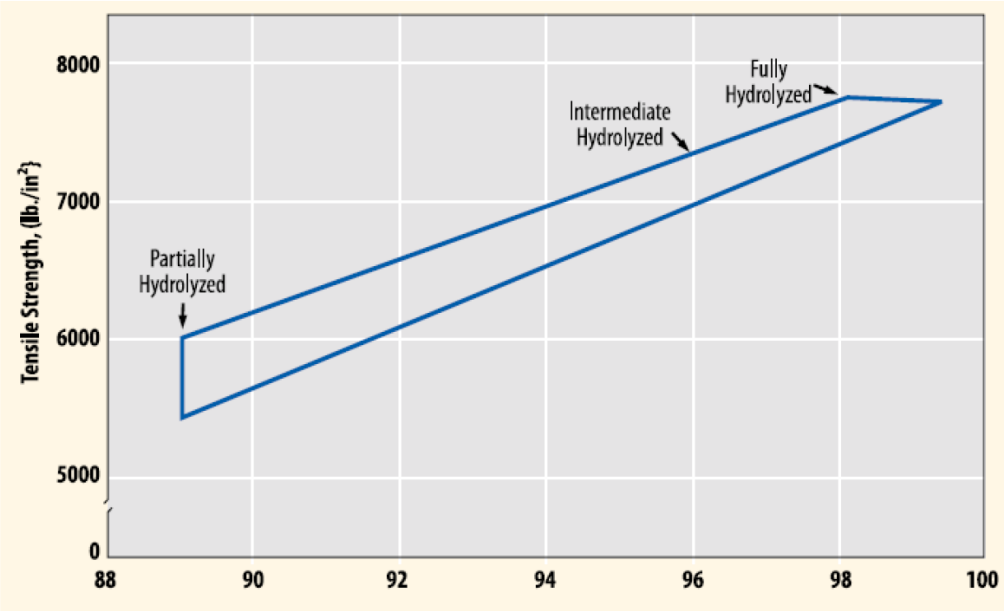
Properties:

- Hydrolyzation of PVA >99%, leads to formation of intense hydrogen bonding which improves the strength of the PVA film
- Such PVA is not easily soluble in water and hence requires high temperature, that makes desizing difficult
- Super hydrolyzed is generally not preferred for sizing
- Partial hydrolyzed PVA adheres to yarns better

Sizing: Material-Polyvinyl Alcohol (PVA)



Hydrogen bonding in PVA



Effect of hydrolysis on the strength of PVA film

Sizing: PVA properties

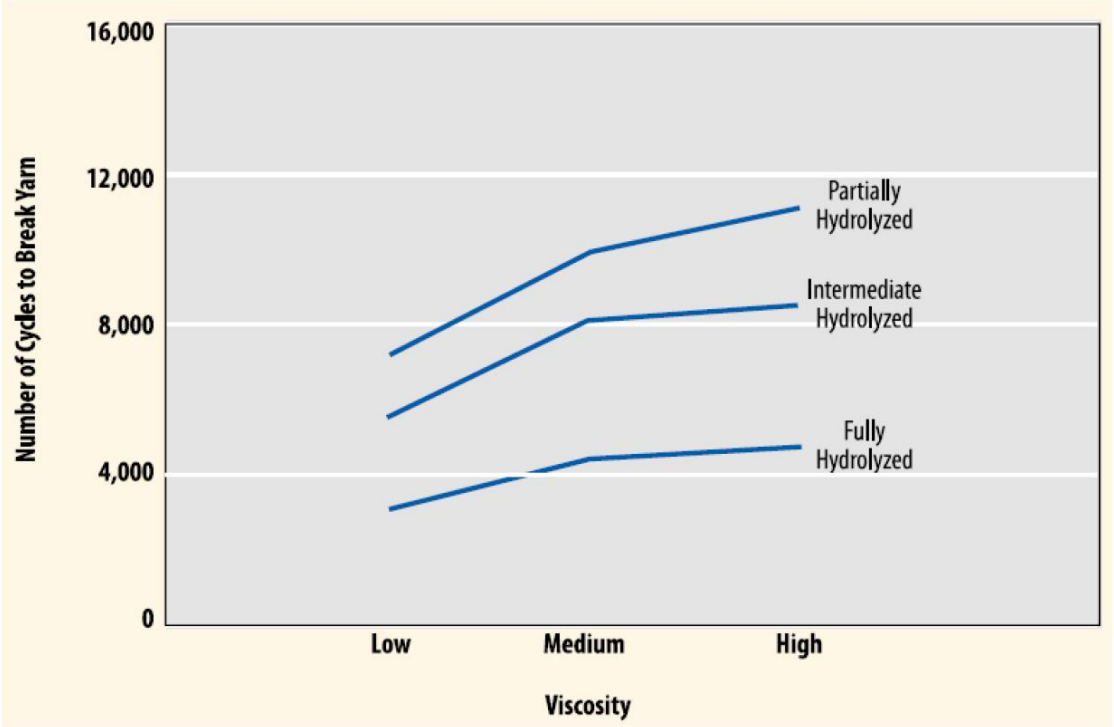
The partially hydrolyzed PVA provides better waving performance in terms of (a) Less shedding or dropping of size (b) Lower yarn hairiness and (c) Lower size add-on

Adhesion Properties

Type of fibre	Adhesion strength (g/mm^2)	
	Partially hydrolyzed	Fully hydrolyzed
Acetate	10	2
Nylon	11	6
Acrylic	9	4
Polyester	7	1

DH and applications

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



Abrasion resistance of yarns sized with PVA

Sizing: Typical Steps Followed in the Industry to Prepare the Size Paste

- Take standard volume (700 litres) of water (normal temperature) into the premixture through water flow meter, start the stirrer.
- Properly weigh all the chemicals required.
- Add modified starch, PVA and then Acrylic binder slowly into the pre-mixture vessel.
- Stir the mixture for 15 minutes.
- Start the stirrer of the cooker, transfer the mixture to the closed cooker from premixture vessel. Close all the open valves of the cooker.
- Heat the cooker mixture with the injection of direct steam, steam will auto cut when the cooker temperature reaches the preset limit (110^{o} C). It takes around 30 to 35 minutes.
- Cook the mixture for another 40 minutes, the temperature of the cooker will reach to around 120 to 125^{o} C depending on the size recipe.
- Start the stirrer of the storage vessel and then transfer the cooked size paste to the respective storage vessels.
- Add lubricant with the size paste at storage.
- Maintain storage temperature at around 80-90^{o} C.
- Paste is ready to transfer to the sow box of sizing machine.

Carded cotton yarn

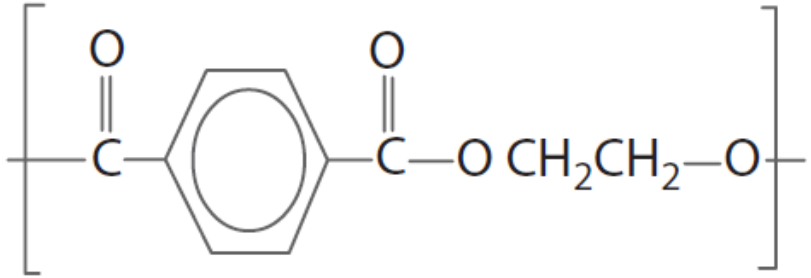
Modified starch	:	10.5 % on the weight of water
PVA	:	2.86 %
Acrylic binder (Liquid)	:	6.6 %
Lubricant	:	0.7 %.

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

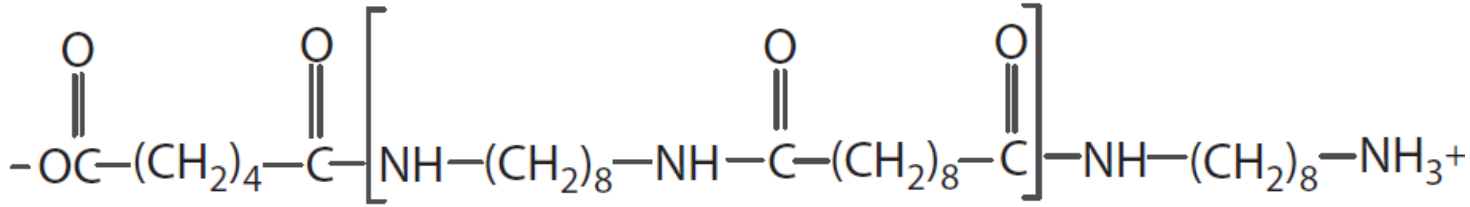
Sizing: Sizing of Synthetic Fibers

The basic problems associated with sizing of synthetic yarns-

- Absence of −OH groups
- Hydrophobicity of material



Molecular structure of a polyester



Molecular structure of a polyamide

For sizing of these hydrophobic yarns, one has to primarily depend on the following forces and some desirable properties-

- van der Waals forces
- Dipole–dipole forces

❖ Adhesive and fiber have to be brought into close proximity.
❖ Adhesive should not contain steric hindering groups.
❖ Adhesive molecules must be as linear as possible.
❖ Adhesive material should have favorable dipole–dipole interacting (polar) groups.

Type of Fiber	Chemical Nature of Size Adhesive
Polyester	Vinyl copolymers
Polyamide and polyacrylonitrile	Polyacrylic acid
Acetate	Polyvinyl alcohol