Sizing

Sizing

During the weaving process, the warp yarns are subjected to abrasion with various loom components like back rest, heald eyes, reed, front rest etc.

In shedding operation, warp yarns also abrade against each other

Objectives

To improve the weave ability of yarns by applying a uniform coating on the yarn surface so that protruding hairs are laid on the yarn surface.

Prevents the warp yarn breakage due to abrasion with neighbouring yarns or with back rest, heald eye and reed.

It improves the yarn strength by 10 to 20%

Characteristics of Sized Yarn

✓Higher strength

✓Lower elongation

✓Higher bending rigidity

✓Higher abrasion resistance

✓Lower hairiness

✓Lower frictional resistance

Sizing Definitions

Size paste concentration, size pick-up and size add-on

$$\text{Size concentration (\%)} = \frac{\text{Oven dry mass of size materials}}{\text{Mass of size paste}} \times 100 = \frac{S}{P} \times 100$$

$$\text{Size add on(\%)} = \frac{\text{Oven dry mass of size materials}}{\text{Oven dry mass of unsized yarns}} \times 100 = \frac{S}{Y} \times 100$$

$$\text{Wet Pick up} = \frac{\text{Mass of size paste}}{\text{Oven dry mass of unzized yarns}} = \frac{P}{Y}$$

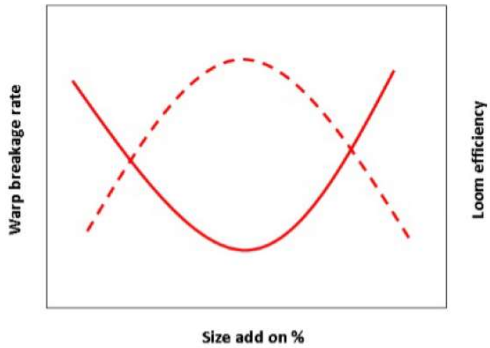
$$= \left(\frac{S}{Y} \times 100\right) \times \left(\frac{P}{S} \times \frac{1}{100}\right)$$

$$= \frac{\text{Add on (\%)}}{\text{Concentration (\%)}}$$

Sizing-weaving Curve

At low level of size add-on, the yarn is not adequately covered by the size film, so high breakage rate

If size add-on is higher than the optimum level then warp breakage rate increases due to the loss of elongation and increase in bending rigidity of the yarns



Optimum level of size add-on

The optimum level of size add-on will depend on the following factors:

✓Type of fibre

✓Type of size materials

✓Yarn spinning technology

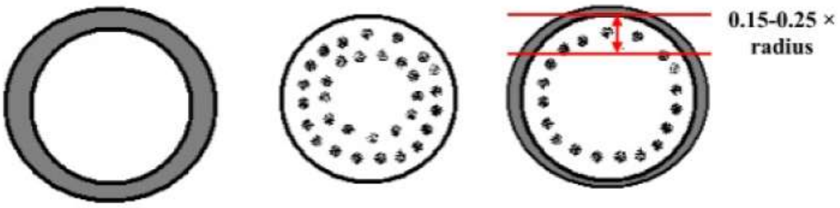
✓Yarn count and twist

✓Level of hairiness in the yarn

✓Loom type and loom speed

Size add-on and weaving performance

Different weaving performances even at the same level of size add-on due to differences in (a) Size penetration and (b) Size coating or encapsulation.

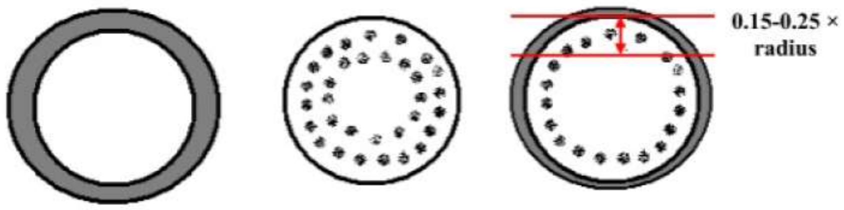


Size add-on and weaving performance

First case where size material formed a uniform coating on yarn surface, but penetration of size material is in adequate.

This tackle hairiness problem, however poor adhesion of size film with yarn

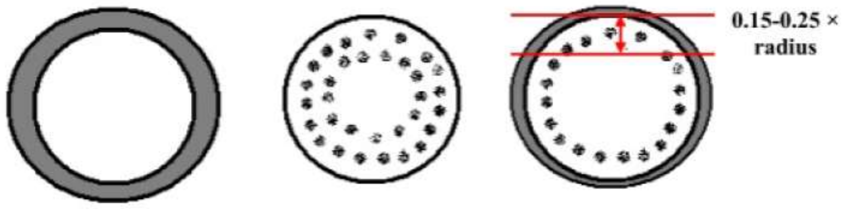
During abrasion with various machine parts, size will fall and thus poor weaving performance



Size add-on and weaving performance

In second case, inadequate coating or encapsulation on the yarn surface, so limited protection against abrasion.

Size materials penetrated too much inside yarn so longer desizing in future

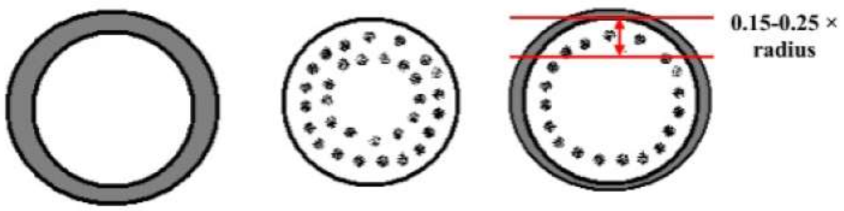


Size add-on and weaving performance

In third case, thin uniform coating formation on the yarn surface as well as some penetration of size in the yarn structure

This ensures good adhesion between the yarn and the size coating and prevent dropping of size film

Optimum size penetration to 15-25% of yarn radius.



Desirable Properties of Sizing Materials

1. The sizing material must form a smooth and uniform coating the yarn surface.
2. The size film should adhere with the fibres strongly to prevent dropping of size film
3. The film should also have enough flexibility to allow the flexing or bending of yarns around the back rest, heald eyes and other loom components.

Desirable Properties of Sizing Materials

Table 4.1: Essential and desirable properties of sizing materials

Film forming	Controllable viscosity
Adhesion	Easy removal and recyclability
Optimum penetration	Neutral pH
Film flexibility and elasticity	Non-polluting
Lubrication	Cheap
Bacterial resistance	

Requirements of sizing material

It depends on the following factors.

✓Type of fibre (cotton, viscose, nylon, polyester etc.)

✓Type of yarn (ring, rotor, friction, air-jet etc.)

✓Type of loom (shuttle, projectile, air-jet, water jet etc)

✓Construction features (weave, yarn counts and sett)

Composition of Sizing Material

Composed of adhesive, softening agent, antimicrobial agent etc.

The adhesive part responsible for forming film and adhering with fibres.

Softening agent makes film flexible so that it can bend easily without cracks.

Antimicrobial agents are added to avoid growth of mildew for longer storage

Composition of Sizing Material: Adhesive agent

Cotton yarns are sized by starch

Advantages

✓Starch is chemically same with cotton

✓Desizing is easy

✓Relatively cheap

Disadvantages

×Starch gives very stiff film.

×Cooking of starch is required

×Starch has poor bacterial resistance.

Composition of Sizing Material: Softening agent

The softening materials compensates for the abrasive and harsh feel given by starch

Softeners also lubricate yarns so that they can pass over machines parts without shedding.

Mutton tallow which is composed of glycerides of palmitic, stearic and oleic acids is used as softeners.

Sources of Starch

Starches are available from seed, root or pith of plants.

✓Corn, rice and wheat are the examples of seed starch.

✓Potato and Tapioca starches are obtained from roots.

✓Sago starch is obtained from pith.

Corn (Maize) starch

Corn (Maize) starch is most popular type of starch used in textile sizing.

Around 50% of the corn is composed of starch.

Corn starch is generally preferred for sizing of coarse and medium count yarns.

Potato starch

Potato yields around 20% starch.

It is slow congealing type.

It forms a smooth and pliable film on the yarn body.

Potato starch is preferred for sizing finer yarns.

Chemical Structure of Starch

✓Chemically starch and cellulose same

✓Both are polymer of glucose

✓Glucose can have two structural form known as α and β

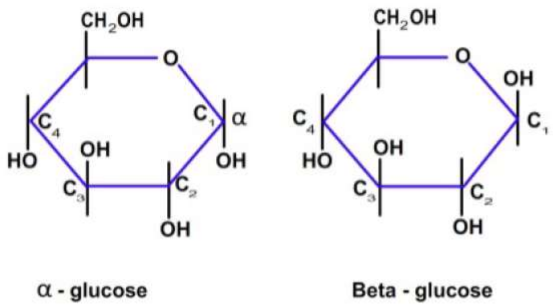


Figure 4.3: Structure of α and β glucose

Chemical Structure of Starch

Starches are having two components.

✓The straight chain component is called amylose.

✓The branched chain component is called amylopectin.

Table 4.2: Differences between amylose and amylopectin

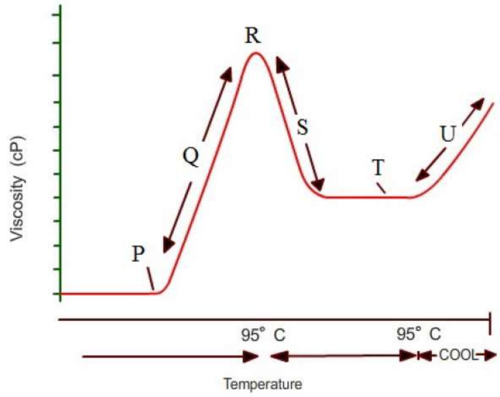
Amylose	Amylopectin
Provides strength	Prevents rapid gelling
Water soluble	Water insoluble
Low molecular weight	Relatively high molecular weight
20-30%	70-80%

In potato starch their ratio is 20:80 whereas in wheat starch the ratio is 25: 75.

Cooking of Starch

Cooking of starch is required to make it soluble in water.

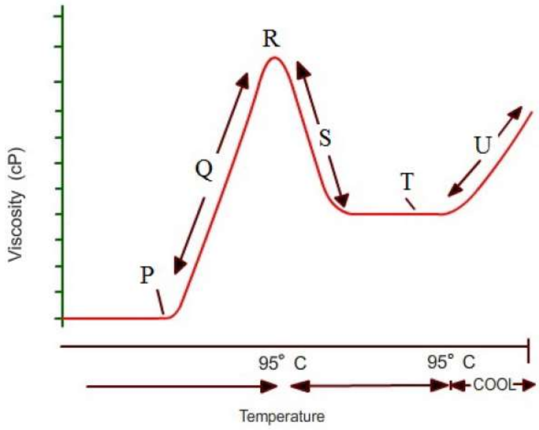
The change in viscosity of starch solution during cooking is shown in Figure



Cooking of Starch

External heat energy is required for penetration of water molecule within structure.

The temperature at which the thermal energy becomes sufficient to overcome hydrogen bonding within structure is called 'gelatinisation' temperature (P).

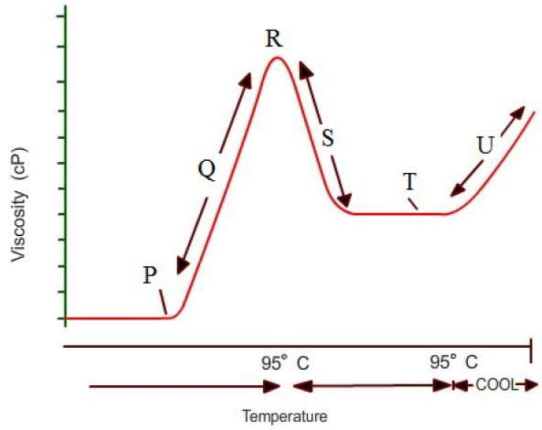


Cooking of Starch

As water penetrates, chain molecules are pushed away from each other causing swelling of starch granule.

This is marked by increased in viscosity of solution (Q).

This continues up to point R.

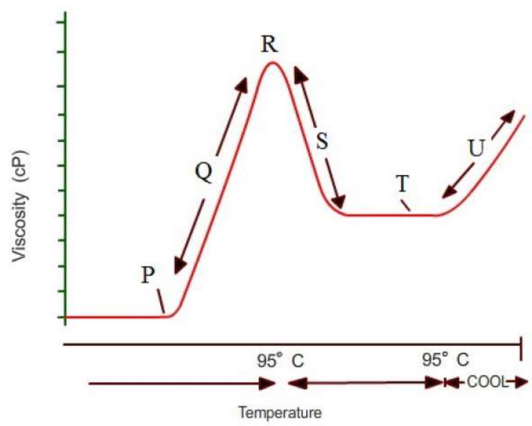


Cooking of Starch

Due to continuous stirring, starch granules break.

The chain molecules of amylose and amylopection come out causing reduction in viscosity (T).

When all granules burst, viscosity stabilizes (T).



Cooking of Starch

When the solution is cooled, starch gels due to the formation of a rigid interlocked micelle-like structure (U).

This gel form of starch can form a continuous coating on yarn surface.