Yarn preparation for weaving
Definition: Textile Fabric

- A textile fabric is defined as an assembly of fibres, yarns or combinations of these.

- Techniques for fabric manufacturing:
  - Weaving
  - Knitting
  - Braiding
  - Tufting
  - Nonwoven manufacturing
Manufacturing steps of woven fabrics

Weaving: It is the process of interlacement of warp with weft
Warp: Longitudinal yarn in the fabric is called warp
Weft: Lateral/crosswise yarn in the fabric is weft
Yarn preparation for weaving

Warp yarn preparation

- Winding
- Warping
- Sizing/slashing
- Drawing-in or tying-in

Weaving

Weft yarn preparation

- Winding
Warping

- It is the process of preparing a double flanged beam of warp yarns arranged parallel to each other.
Warping (3 Types)

- Beam/Direct warping
  - (Grey/Monocolour fabric)
- Sectional/Indirect warping
  - (Warp patterns: Stripes and Checks)
- Ball warping
  - (Denim fabric)
Beam warping

- It is suitable for grey or monocolored fabric preparation.
- The maximum number of warp yarns in a beam can be 600.
Beam warping

- Creel
- Warp yarn
- Head stock
Beam warping

Creel

Head stock
Beam warping (Quality aspects)

- Exact thread guidance
- No crossed threads
- Cylindrically wound beams: no slip between press roller and yarn package
- Warp length accuracy within 1 per thousand
- No cutting-in by threads on the comb
- Fewer rolled-in ends through short braking distances
- Short braking distance
- Simple insertion of threads into the comb
- Workplace designed according to ergonomic principles
Sectional warping

- It is suitable for all warp patterned fabrics e.g. stripes and checks.
- Warping is carried out section by section.
- A single beam is prepared which may or may not be sized.
- Sometimes this process is carried out for 2-ply synthetic warps where no sizing is needed.
- It is a two stage process. Warping onto the drum and Beaming.
- Creel capacity can be lower.
Sectional warping machine

Creel

Head stock
Sectional warping

Yarn from creel

Head stock

Section drum

Creel
Sectional warping

The creel

Head stock
The yarns are laid sectionwise, starting from the conical base side. The first section is supported by the conicity of the base and the subsequent sections supported by the conicity formed by the preceding section.
Sectional warping

The newly developed machine with its reed headstock integrated into the machine superstructure allows production speeds never previously achieved, thanks to its innovative control system. The machine has the following special technical features:

• Production of warp sections with a minimum width of 4 mm or (depending on yarn fineness) minimum 12 – 24 threads. With maximum end numbers of 480 -560 threads and a section width of up to 150 mm, the machine can be fine-tuned for flexible production.

• The time for each thread separation at a lease or sizing split is 7 seconds per separation process

• A maximum warping speed of 750 m/min allows production to be optimised to suit yarn properties.

• The perfect thread tension between creel and machine for the warping process ensured by the use of a proven section tension control and a controlled beaming tension system forms the basis for warp quality that meets the highest requirements.

• The machine is available with a working width of 2,200 mm for the traditional clothing sector and 3,600 mm for decorative fabrics and furniture coverings.
Leasing is a process of layer separation to facilitate the subsequent drawing-in process and weaving. A lease band is inserted between the layers.
The beaming operation

In the second step, all yarns are simultaneously transferred from the section drum onto a double flanged warper’s beam.
Ball warping

- It is a process in which warping is done in rope form.
- A ball warp beam is prepared for subsequent process.
- It is suitable for denim fabric manufacturing, involving rope dyeing process.
- It is also a 2 stage process; Ball warp winding and Long chain beaming.
- Dyeing is done before beaming operation.
Initially the warps are wound in rope form on a cylindrical barrel.
Ball warping

Dyeing is carried out in the rope form of the warp yarns.
In the second stage: (Long chain beaming), The ends are spreaded to open width form.
Warping machine manufacturers worldwide

- Benninger
- Scharer
- Sucker Muller Hacoba
- Yamada
- West point
- Karl Mayer
- Suzuki
Sizing
Objectives

To improve weavability (weaving potential) of warp yarn by,

- Increasing strength
- Reducing hairiness
- Improving abrasion resistance
- Retaining elasticity
- Retaining extensibility to some extent
- Maintaining the flexing behavior
Objectives achieved by

- Coating of yarn surface with a suitable film forming polymeric material

- By penetration of the adhesive/binding agent into the core of the yarn
Sizing machine

Different zones of the machine
Sizing machine

- Drying
- Creel
- Sizing zone
- Head stock
Sizing (Quality & Productivity)

**Highest quality**

- *Uniformly optimal sizing*
- *Low hairiness*
- *Low stretch during sizing*
- *Automatic section tension control*
- *High reproducibility*

**High productivity**

- *Simple attendance*
- *Automatic monitoring of all parameters*
- *Comprehensive recipe management*
Sizing quality achieved through...

• *Flexible squeeze rollers for uniform sizing*
• *Air-cushion cylinder for hysteresis free pressure application*
• *Textured or structured surface for reduced hairiness*
• *Programmable squeeze pressure curve*
• *Simple attendance at the size box*
• *Clearly defined wet splitting per size box*
The sow box

- Immersion roller
- Size roller
- Squeeze roller
- Size pump
Pre-wetting in sizing

**Savings**
- Size savings of up to 50%
- Improved weaving characteristics
- Lower effluent treatment costs

**High productivity**
- Optimal weaving efficiency
- Fewer warp beam changes thanks to increased warp lengths
Reproducible size preparation

Your profit from these advantages

- Reproducible size recipes to high quality standard
- Fully automatic preparation and supply
- Personnel costs cut
- Low investment costs
Sizing machine manufacturers

- Benninger
- Yamada
- Sucker Muller Hacoba
- West Point
Size materials

**Essential Ingredients**
- Adhesive/Binder
- Softener
- Wetting agent
Desirable Ingredients (Depending upon requirement)

- Oxidizing/Reducing agents
- Weighting agents
- Brightening agent
- Antifoaming agent
- Delustering agent
- Antistatic agent
Adhesive/Binder

- **Natural**
  - Starch from maize, rice, wheat, potato etc.
  - Gums from plants

- **Synthetic**
  - Polyvinyl Accohol (PVA)
  - Carboxymethyl Cellulose (CMC)
  - Polyacrylate (PA)

To bind the fibre material together and consolidation of yarn
Softener/Lubricating agent

- Oils and Fats from Plants
  - Oil from Seeds of plants; Castor, sunflower etc.
  - Vegetable oils
- Animal Fats
  - Mutton tallow

To maintain pliability of yarn by softening and lubricating
Wetting agent

- Turkey Red Oil (TRO)

To reduce surface tension for spreading of size material on yarn surface
Oxidizing and Reducing agent

Depending upon requirement of the size paste
Weighting agent

- Gypsum salt (CaSO$_4$, 2H$_2$O)
- CaCO$_3$

To increase the weight of fabric, if sold on weight basis
Optical Brightening agent

- Ranipal
- Tinobal blue

To improve brightness of light coloured yarn and thereby the fabrics to be sold in gray state
Antifoaming agents

- Turkey Red Oil (TRO)

To prevent formation of foam during size paste preparation
Delustering agent

- Titanium dioxide (TiO$_2$)

To reduce luster in case of glaring synthetic yarns
Antistatic agent

- Sapkostat oil

To dissipate static charge generated in synthetic yarns due to friction with other yarns or metal surfaces
Size paste concentration

Size paste concentration %

= \frac{\text{Oven dry weight of size material}}{\text{Total weight of size paste}} \times 100
Size pick up

Size pick up % =
\[
\frac{\text{Weight of size paste taken up}}{\text{Oven dry weight of unsized yarn}} \times 100
\]
Size add on

Size add on % =

\[ \text{Oven dry weight of size material} \times 100 \]
\[ \text{Oven dry weight of unsized yarn} \]
Size parameters relationship

- Size add on % =

\[
\text{Size paste concentration \%} \times \frac{\text{Size pick up \%}}{100}
\]
Modern techniques in sizing

- Cold sizing
- Pre-wet sizing
- Wet splitting
- Dye sizing (Indigo/Vat)
### Cold sizing

<table>
<thead>
<tr>
<th>Properties</th>
<th>Cold Size 1</th>
<th>Cold Size 2</th>
<th>Cold Size 3</th>
<th>Cold Size 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical State</td>
<td>Viscous Liquid</td>
<td>Solid Wax</td>
<td>Viscous Liquid</td>
<td>Viscous Liquid</td>
</tr>
<tr>
<td>Appearance</td>
<td>Clear</td>
<td>Hazy</td>
<td>Reddish/Brownish</td>
<td>Clear to slightly hazy</td>
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<tr>
<td>Viscosity (Time to flow) at 30° c</td>
<td>20 ± 2 seconds</td>
<td>-</td>
<td>20± 2 seconds</td>
<td>18 ± 2 seconds</td>
</tr>
<tr>
<td>pH</td>
<td>4 - 5</td>
<td>-</td>
<td>6.5 – 8.5</td>
<td>5 - 6</td>
</tr>
<tr>
<td>Solubility</td>
<td>Soluble in cold water</td>
<td>Soluble in warm water</td>
<td>Soluble in cold water</td>
<td>Easily soluble in cold water</td>
</tr>
<tr>
<td>Solid Content</td>
<td>6%</td>
<td>100%</td>
<td>6%</td>
<td>6%</td>
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<tr>
<td>Chemical Constituent</td>
<td>Poly Methyl Acrylate</td>
<td>Poly Ethylene Glycol</td>
<td>Poly Ethylene Glycol</td>
<td>Poly Ether Glycol</td>
</tr>
<tr>
<td>Chemical Formula</td>
<td>(C₄H₆O₂)ₙ</td>
<td>(C₂H₄O)ₙ</td>
<td>(C₂H₄O)ₙ</td>
<td>(C₂H₄O)ₙ</td>
</tr>
<tr>
<td>Molecular Weight</td>
<td>200-400</td>
<td>500-700</td>
<td>200-300</td>
<td>150-200</td>
</tr>
</tbody>
</table>
Existing Tangential Application

1- Creel
2- Guide Rollers
3- Reed
4- Size Box
5- Sectional Warping Drum
Modified Version Adopted

1- Creel
2- Guide Rollers
3- Sow Box
4- Applicator Roller
5- Light Weight Top Squeeze Roller
6- Reed
7- Sectional Warping Drum
BREAKAGE MECHANISM OF SINGLE UNSIZED YARNS
BREAKAGE MECHANISM OF SIZED YARNS