

# Water saving in Textile and Garment factories (Dyeing, Washing and Finishing)

Promotion of Sustainability in the Textile and Garment Industry in Asia - FABRIC

Day 4: Presentation 2

# Water Saving– Denim dyeing

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Contents

- **Denim dyeing**
  - ✓ Rope dyeing
  - ✓ Slasher dyeing
- **Water saving opportunities**



**At the end of this module, you will be able to**

- Understand the denim dyeing process
- assess possible changes and impacts in process steps and production technologies
- apply process specific low water consumption technologies



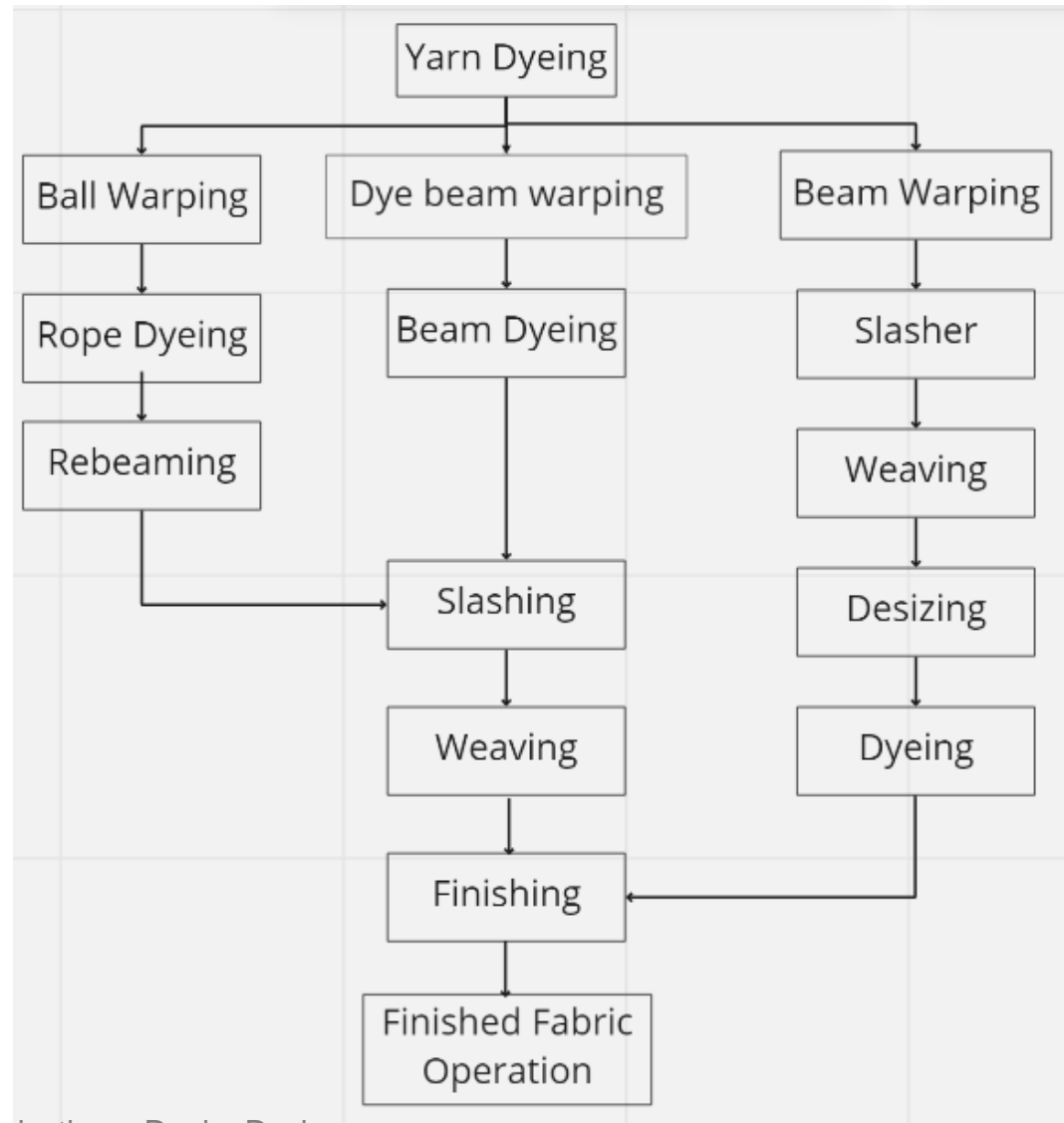
# Denim dyeing process

# Fundamentals of Denim

- Denim is a type of woven fabric predominantly a 3/1 warp faced twill but also produced from weaves like: Left hand twill, right hand twill, broken twill, cross hatches, cords, dobby's, structures
- Denim is dominantly made of cotton fibers and in some cases, it is blended with other types of fibers to add special features.
- Usually 4 oz. to 16 oz. / sq.yds in weight
- It is a rugged and sturdy fabric in feel.



# Flow chart of Denim production



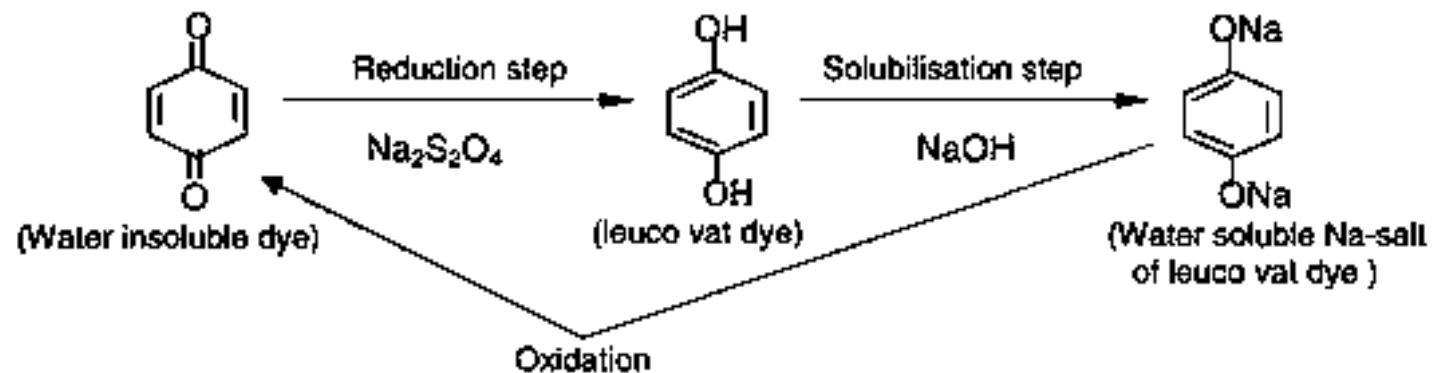


# Fundamentals of Denim dyeing

- Warp yarn is coloured
- Colour may be blue, black, green or it's variation
- Weft yarns are always in its natural color
- A Surface Dyeing technique where colors are only attached on the surface of the fabric or yarn instead of getting into to the core of the yarn/fabric
- Assists in easy fading during garment wash

# Fundamentals of Denim dyeing

- Mostly water insoluble indigo or sulphur dye are used
- Soluble-Oxidation-Insoluble on the surface
- Reducing agent, alkali, and oxidizing agent (e.g. air)
- pH, amount of reducing agent, immersion time, temperature, oxidation time



# Colour of Denim

- Indigo blue
- Indigo black
- Sulfur black
- Sulfur black bottoming – indigo topping
- Indigo bottoming –Sulfur black topping
- Sandwich – Sulfur black-indigo-sulfur or vice versa



Bottoming Effect (Sulfur Dye + Indigo)



Topping Effect (Indigo + Sulfur Dye)



# Dyeing Methods

- Slasher/ Open warp/ Sheet dyeing
- Rope/Ball warp/ Chain dyeing

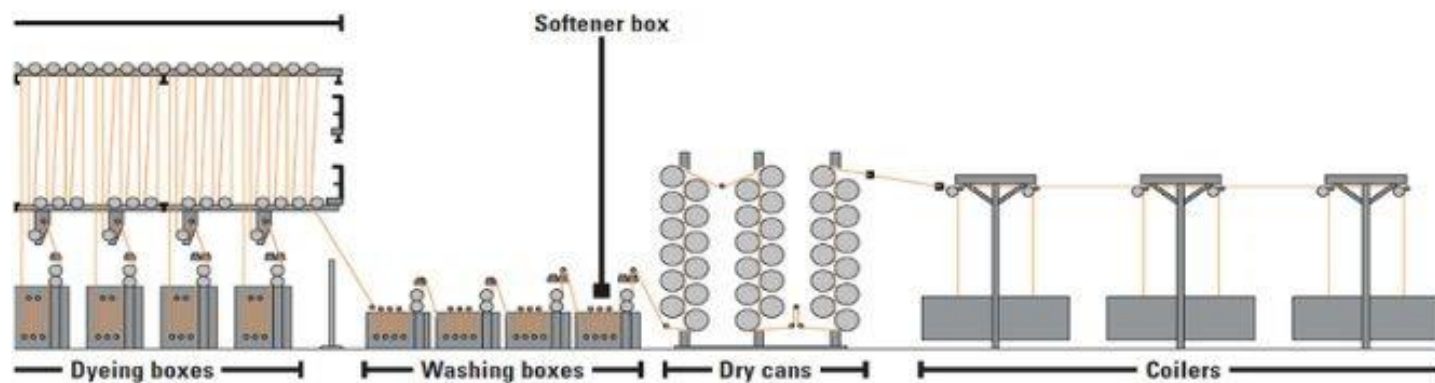
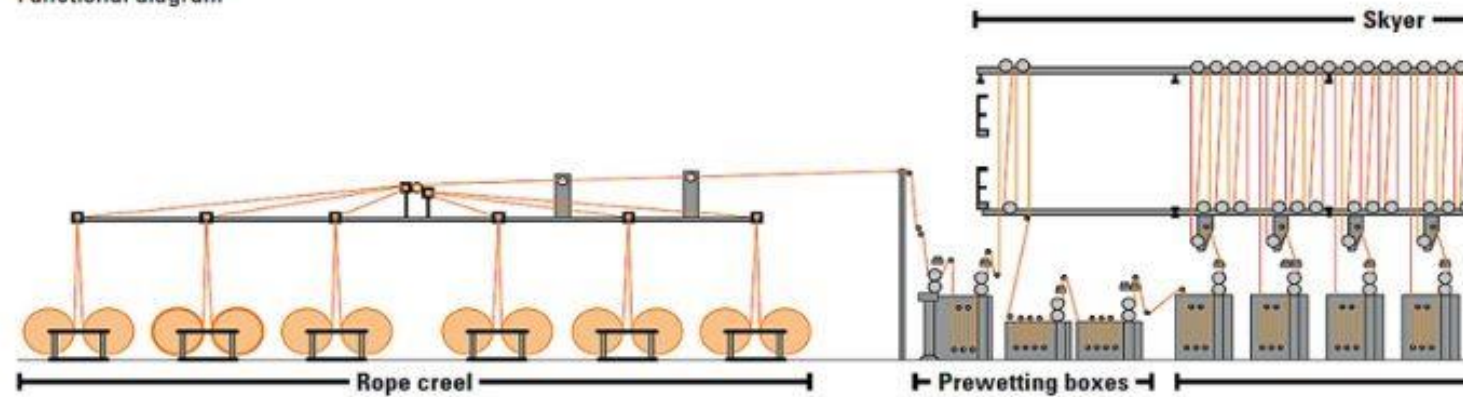
# Rope Dyeing

- The warp yarns are passed through a special comb and lease rods and wound in the form of ropes in ball warp.
- The rope length generally remains up to 2500 meters. Each rope contains 350-400 ends.
- Machine capacity is up to 36 ropes and 14400 threads depending on the size and the width.
- The ropes are dipped into 6-8 dye baths.
- Multiple dipping of the ropes are carried out for ensuring better penetration.
- Skying of the ropes are carried out after each dip for air-oxidation. The shade is built up due to this.
- The yarn count ranges from 1-16 Ne

# Rope Dyeing

## Rope range

### Functional diagram





# Rope Dyeing

Advantages	Disadvantages
No cross-shade variation	A lot of space is required
Wastage of thread is low	Immersion time and oxidation time is comparatively higher
Productivity is high and flexible production	An additional step of opening ropes after dyeing is necessary
Less reducing agent consumption	Less flexibility in changing color
No time loss during lot change	The production cost is high
Versatility in denim production	

# Creeling for Rope beam



Photo Credit: Mohammad Abbas Uddin



# Winding with Automatic slicing in Denim



Photo Credit: Mohammad Abbas Uddin



# Ball Roap beaming



Photo Credit: Mohammad Abbas Uddin



# Ball stockers

- up to 42 beams can be stocked. With automatic loading and unloading



Photo Credit: Mohammad Abbas Uddin



# Rope dyeing

up to 42 ropes can be dyed together, which in turn can make 3 beams from 14 ropes each



Photo Credit: Mohammad Abbas Uddin



# Rope Dyeing Machine

Morrison



Photo Credit: Mohammad Abbas Uddin



# Rope Dyeing Machine

Karl Mayer



Photo Credit: Mohammad Abbas Uddin



# Rope dyeing

up to 42 ropes can be dyed together, which in turn can make 3 beams from 14 ropes each



Photo Credit: Mohammad Abbas Uddin







# Airing





# Washing

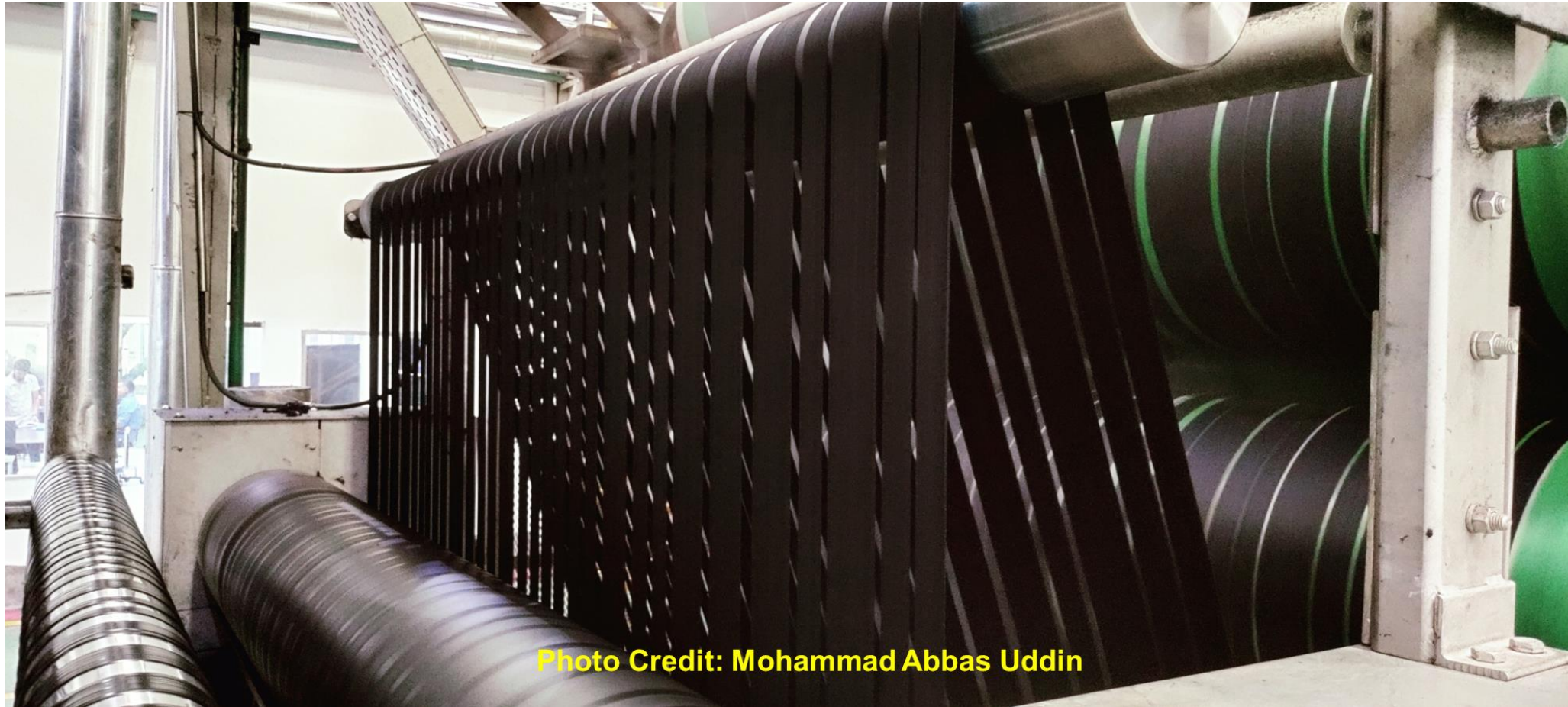


Photo Credit: Mohammad Abbas Uddin



# Shade check at the floor – Rope by rope in light box



Photo Credit: Mohammad Abbas Uddin



## 42 tray/container with 42 ropes coming out after dyeing





# Rope dyeing machine



Photo Credit: Mohammad Abbas Uddin



# Airing in Rope dyeing





# Softener followed by calendaring



Photo Credit: Mohammad Abbas Uddin



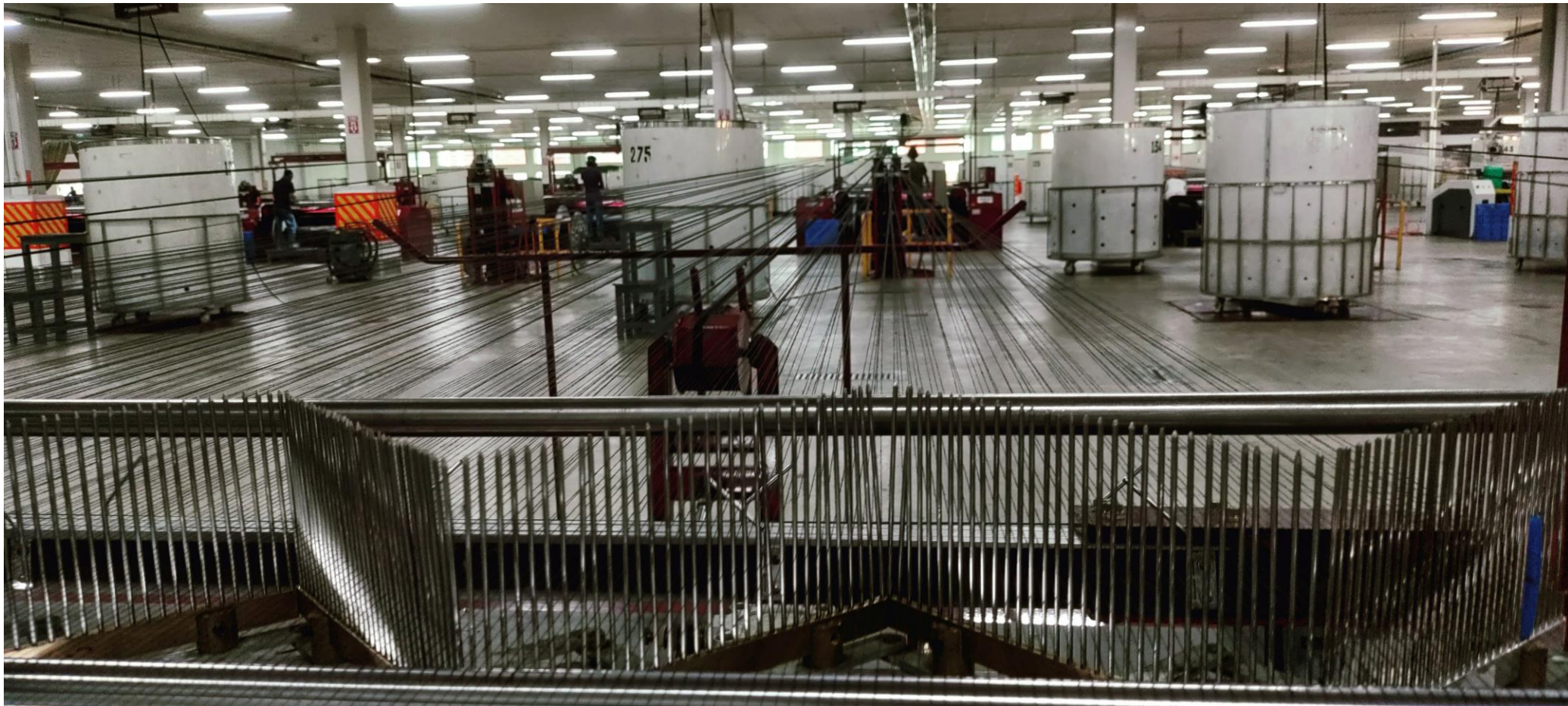
# Calendaring machine



Photo Credit: Mohammad Abbas Uddin



# Rebeaming machine





# Rebeaming machine



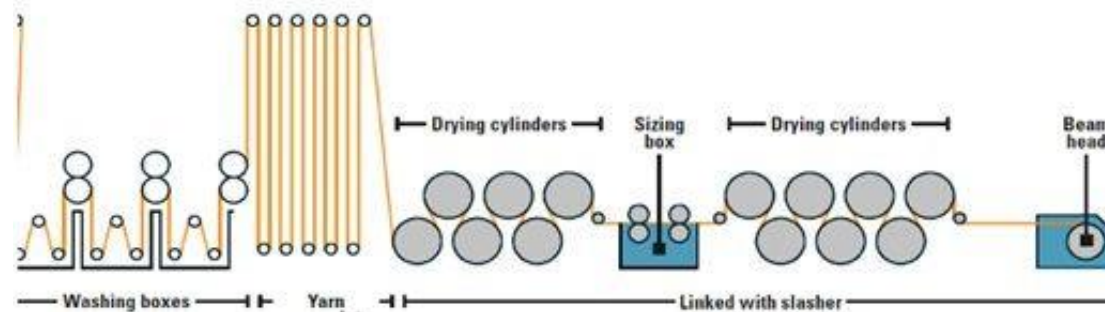
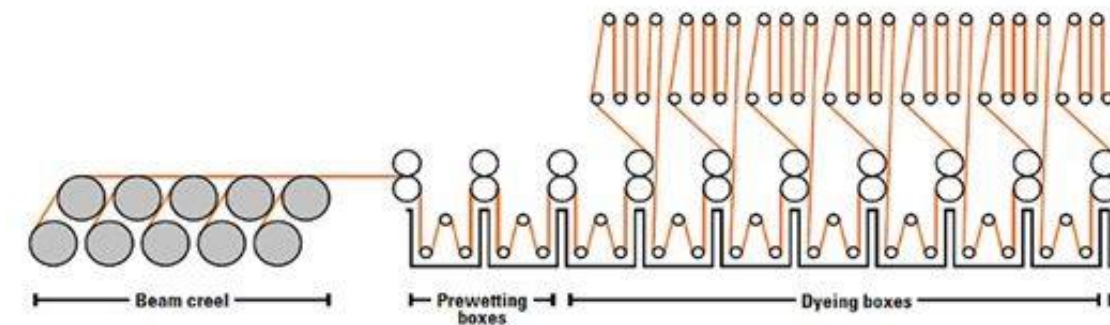
# Slasher Dyeing

- 6-10 dye-baths per vat. Less time is required as each yarn is independently subjected to treatment.
- Warp beams supply warp yarns. The machine capacity is 9500 warp yarns having 300-750 warp yarns per beam.
- Yarn count and denim fabric design determine the number of total warp yarns.
- The yarn count ranges from 1-30 Ne.

# Slasher Dyeing

Sheetdyeing, slasher-dyeing

Functional diagram



# Slasher Dyeing

Advantages	Disadvantages
Less space is required due to compact design	Possibility of cross-shade variation
Oxidation and immersion times are less	Possibility of yarn rupture
Continuous process	Productivity and flexibility in production are low
Flexibility in changing color	Extra time needed for lot change
Production cost is low	No versatility in denim production
	Reducing agent consumption is high



# Slasher dyeing machine



Photo Credit: Mohammad Abbas Uddin



# Slasher dyeing machine



Photo Credit: Mohammad Abbas Uddin



# Slasher dyeing machine



Photo Credit: Mohammad Abbas Uddin



# Padding



**Photo Credit: Mohammad Abbas Uddin**



# Padding liquor





# Liquor Circulation tank in slasher machine



Photo Credit: Mohammad Abbas Uddin

## Three chamber washing as grey stage

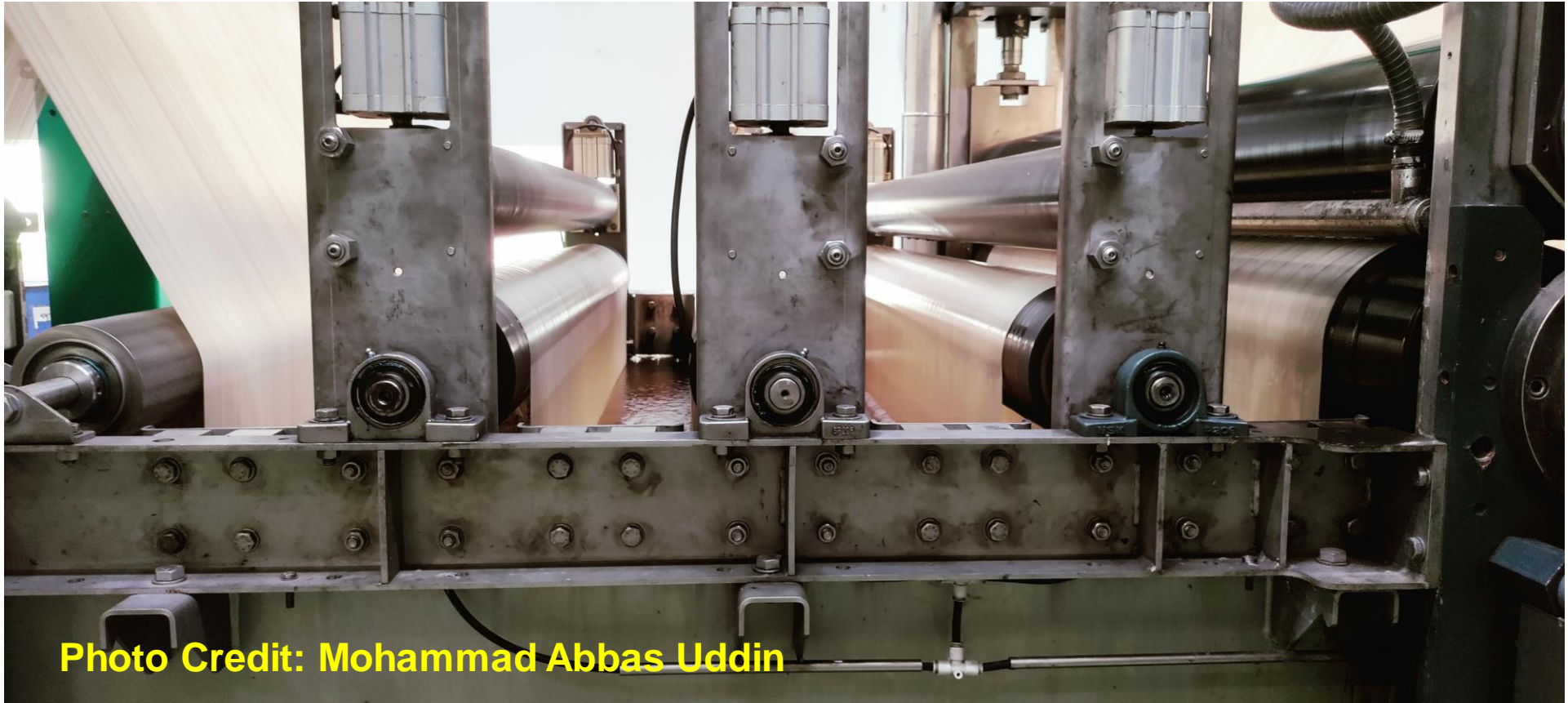


Photo Credit: Mohammad Abbas Uddin



## Three chamber washing as grey stage



Photo Credit: Mohammad Abbas Uddin

## Three chamber washing as grey stage



Photo Credit: Mohammad Abbas Uddin



## Three chamber washing after dyeing



Photo Credit: Mohammad Abbas Uddin



# Singeing plus sanforising machine





# Mercerising machine



Photo Credit: Mohammad Abbas Uddin

# Stenter machine



Photo Credit: Mohammad Abbas Uddin



## Water efficiency – Four ways

- Common Good practices
- Machine modification
- Chemical use
- Process modification

# Common good practices



# Drainage of washing liquid around 50C hot



**Photo Credit: Mohammad Abbas Uddin**

# Calendaring machine – Cooling water goes to WTP

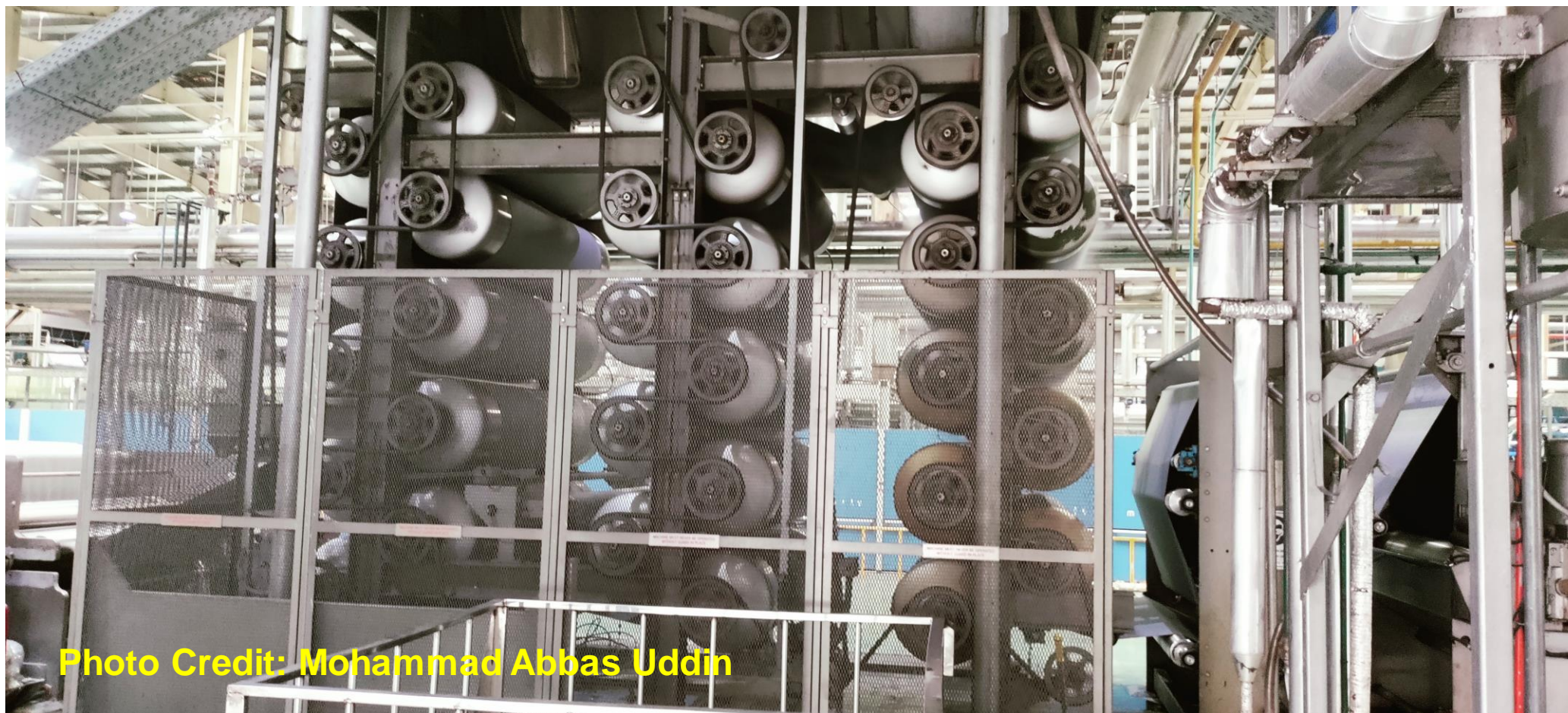


Photo Credit: Mohammad Abbas Uddin



# Machine modification

# Padding liquor

Using 1000 L trough  
instead of 3000 L depth



Photo Credit: Mohammad Abbas Uddin



# Counter current washing

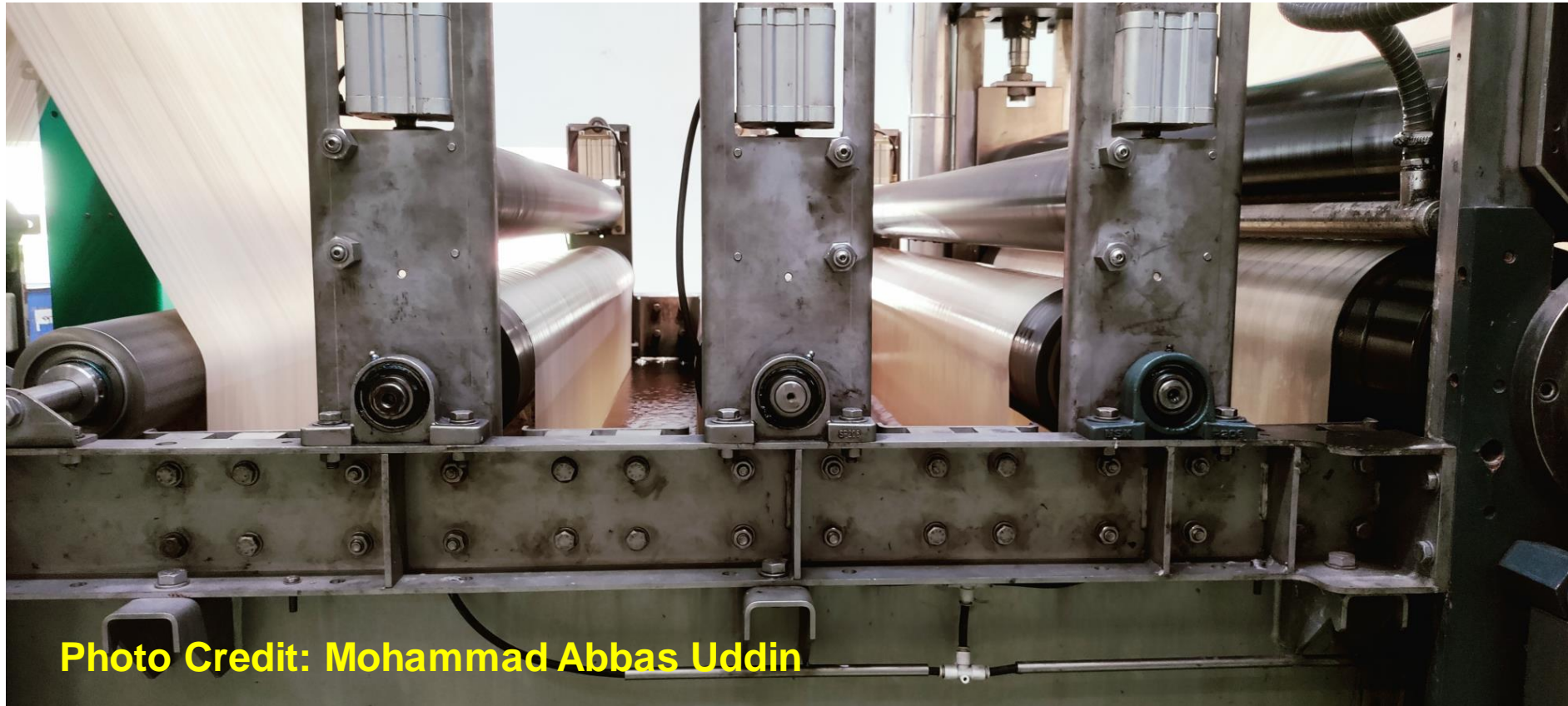


Photo Credit: Mohammad Abbas Uddin

# Change of chemicals



- Using chemical like Asufix that improves the fixation
- Effective desizing that requires less wash
- Reuse of liquid indigo/sulphur

# 1000 L indigo tank



Photo Credit: Mohammad Abbas Uddin

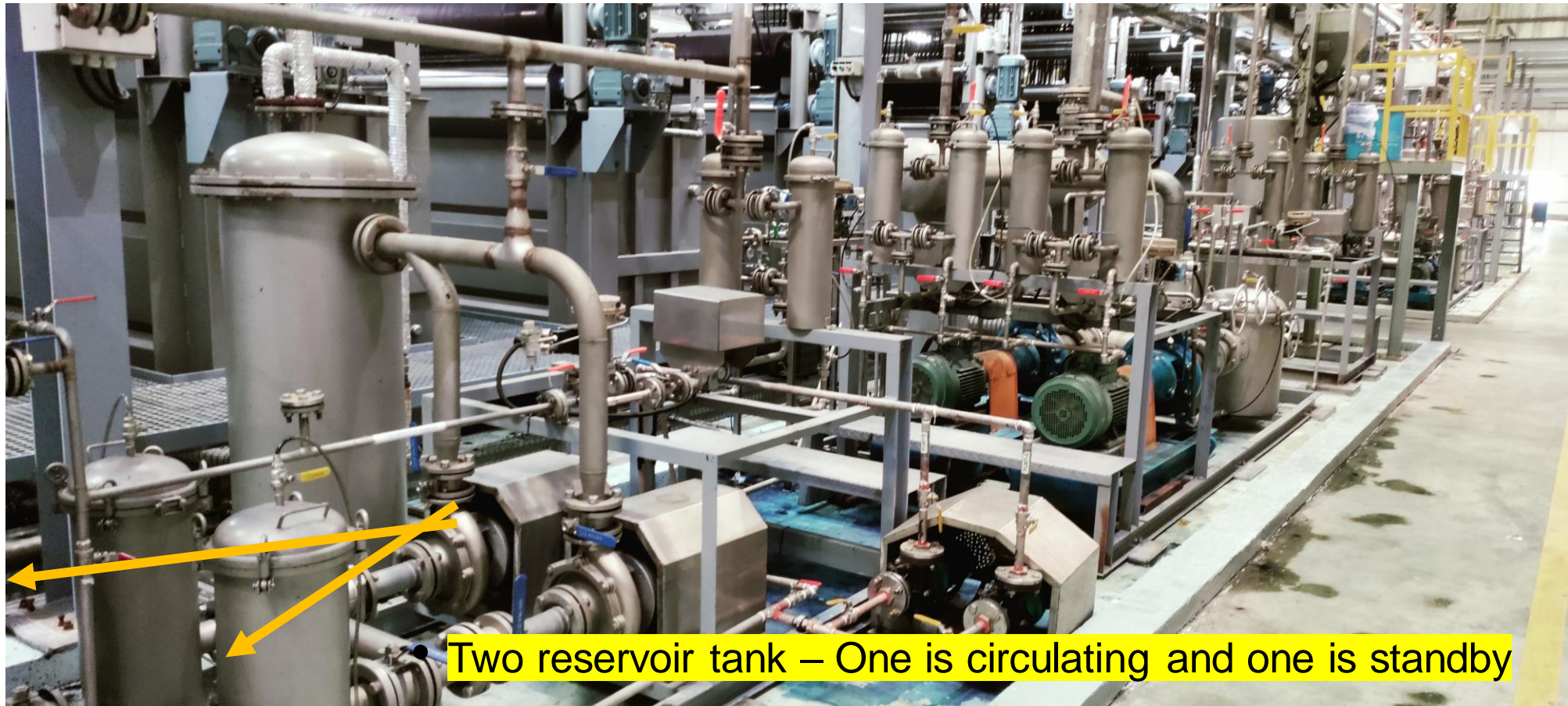


## Circulation tank

It is level with padding trough and always circulating. Indigo/dye are fed into the hopper and through the pump fed into the tank in certain concentration, which is controlled by control panel in the lab. The dosing is set through the control panel. In this way, the concentration in the padding trough kept constant.



## Circulation tank of indigo



• Two reservoir tank – One is circulating and one is standby



# Control panel – controls dosing of production machinery



## Reservoir for liquid return



Photo Credit: Mohammad Abbas Uddin



# Reuse of hydrose and colour



Liquid spectrophotometer for concentration measurement

Autotitration to calculate residual hydrose and indigo directly in gpl

# Process modification



## Padding – Dye solution spray



**Photo Credit: Mohammad Abbas Uddin**

## More add-on liquor

- Ring dyeing rather than penetration
- Increasing number of dipping
- Or increasing dipping time.



Photo Credit:  
Mohammad Abbas Uddin



## Airing

Airing height kept 20-30 fit high to increase the oxidation time, which will offer increased fixation before moving into the next trough for dipping



Photo Credit:  
Mohammad Abbas Uddin

# Conclusion

## Key points to consider

- Denim dyeing is similar to woven dyeing or special as in Ball dyeing
- Water can be saved in various ways including machine and process modification
- Counterwashing technique in washing system
- Reuse of colour liquor is important for reduction of water use
- Process control could enhance right first time colour, hence water saving





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