

# Master Training Program on Water (Water Supply, In-house Processing, End-of-Pipe) in Textile and Garment factories

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

Day 5: Presentation 1

# Yarn dyeing

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## Contents

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- Yarn dyeing machine
  - ✓ Package dyeing
  - ✓ Hank dyeing
  - ✓ Lace/elastic/tape dyeing
- Process Optimisation
- New development

# Basic concept of yarn dyeing

# Basic Concepts of yarn dyeing

## Type of yarn packaging



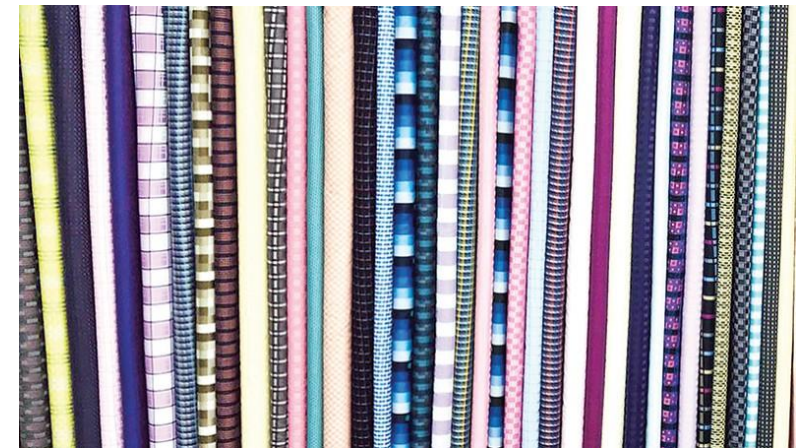
# Basic concept of yarn dyeing

## Yarn dyeing

Dyeing of yarns before they have woven or the knitted into fabrics

### Type of yarn dyeing

- Skein Dyeing – Hank dyeing
- Package Dyeing – Cone dyeing
- Beam Dyeing – a larger version of package dyeing
- Other Dyeing – Tape/elastic/lace



# Basic concept of yarn dyeing

## Hank dyeing



# Skein Dyeing – Hank dyeing





# Package Dyeing – Cone dyeing



# Basic concept of yarn dyeing

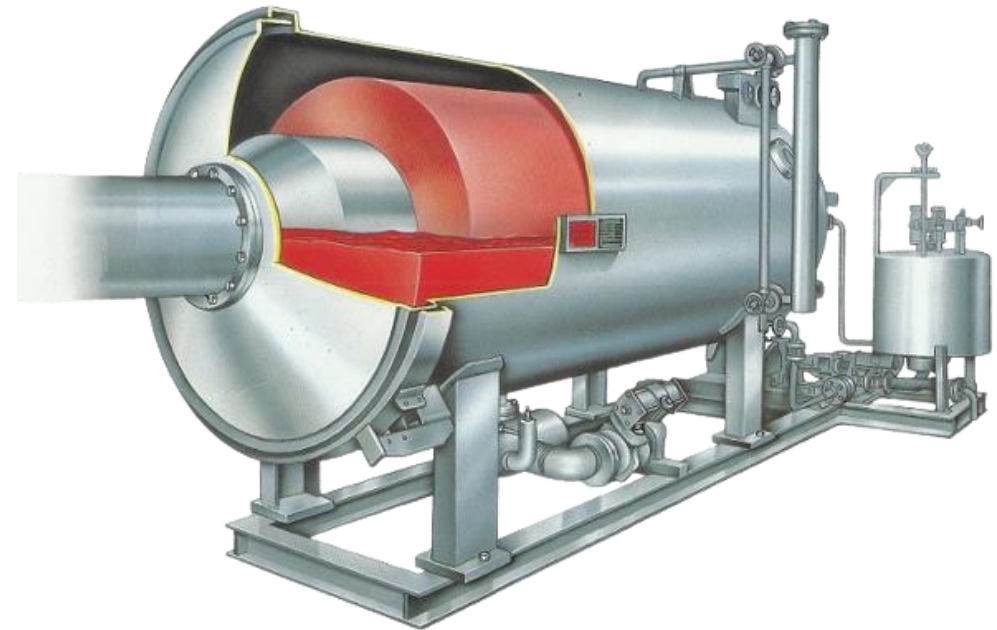
## Package Dyeing – Cone dyeing



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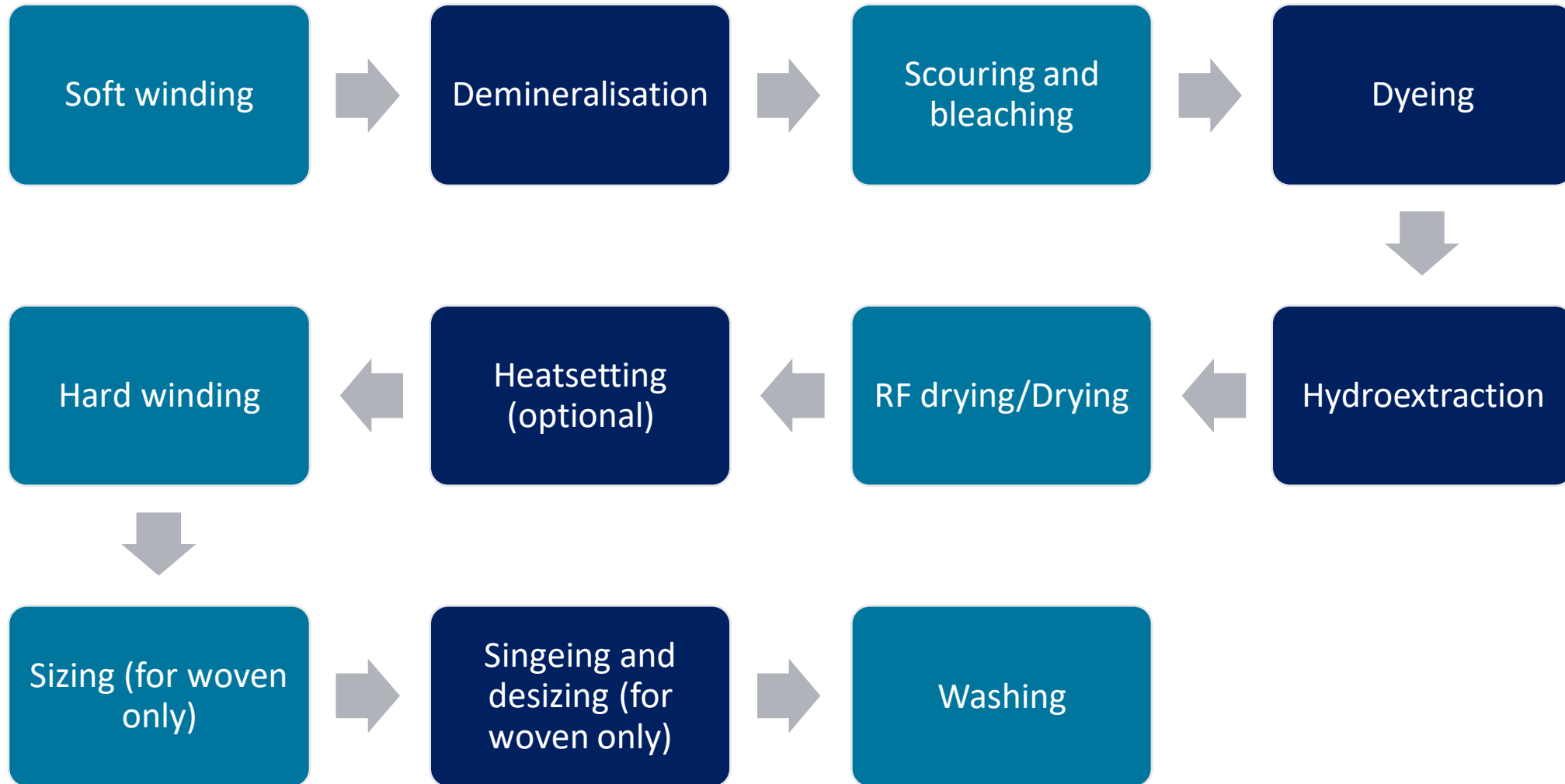
# Basic concept of yarn dyeing

## Beam Dyeing



# Basic concept of yarn dyeing

## Process flow of yarn dyeing



# Example – Actual Yarn dyeing

## Pretreatment

Yarn is wetted fairly with 90% water

↓  
Chemicals are injected for 2 cycles  
10-12 min at 40-50°C

↓  
Chemical dosing at 50°C With Hold  
time 2 min & then Run for 4 min

↓  
NaOH is injected for 5-6 min at  
50°C & the Run for 6 min.

↓  
Temperature is raised to 60°C & then  
H<sub>2</sub>O<sub>2</sub> (50% Soln) is injected at 60°C  
for 6 minute

↓  
Run time 100°C × 48 min.

↓  
Cooling at 75°C

## Dyeing

↓  
Water filling & overflow is done for 10  
minute

↓  
Acetic Acid is added at temperature  
(36-40°C)

↓  
Run for 11 min

↓  
Water filling & overflow is done for 10  
minute

↓  
Drain

↓  
90% water filling

↓  
Chemicals are injected & run for 6 min  
40°C

↓  
Color is mixed at 40°C with rest of the  
chemicals & then dosing for 30 minute

## Washing/Finishing

Overflow for 12 min

↓  
Acetic Acid is added at 40°C for 1 cycle

↓  
Overflow is done for 6-7 minute.

↓  
soaping at 98°C, 30 min to remove  
unfix color

↓  
Sample Check

↓  
If OK than drain

↓  
Over flow for 10 min

↓  
Hot wash is done at 60°C & Run for 11  
min

↓  
Drain for 5 min

# Package Yarn dyeing

# Yarn dyeing machine

## Package Dyeing Machine

- A package dyeing machine is typically a cylindrical vessel, about 2 m high and 2 m wide, with a rounded bottom and lid.
- The yarn is wound into cheeses or cones using perforated former tubes.
- The packages of yarn are inserted onto vertical, perforated spindles in the machine.
- Each spindle typically takes 8–10 packages but the vertical columns of packages do not touch.

# Yarn dyeing machine

## Package Dyeing Machine

- The spacing of the spindles and hence the maximum load depends on the frame diameter and package size.
- The dye liquor is pumped into the base of the frame and up through the perforated spindles.
- The dye liquor flows up the perforated spindle and flows outward through the packages of wound yarn.
- It then flows back down over the outside of the frame and back to the pump. Heating is usually with super-heated steam in coils situated just below the frame carrying the spindles.



# Yarn dyeing machine

## Package preparation

**Package preparation is a crucial step. Some of the factors influencing the stability of a package and its permeability to dye solution are:**

- the denier or tex of the yarns or filaments;
- the degree of twist of the yarn;
- the extent to which the yarn traverses the package (cross-winding) and its tension;
- the degree of swelling or shrinkage that occurs in hot water;
- the actual shape of the package.

# Yarn Dyeing machine - Package dyeing

## Package dyeing



# Yarn dyeing machine - Package dyeing

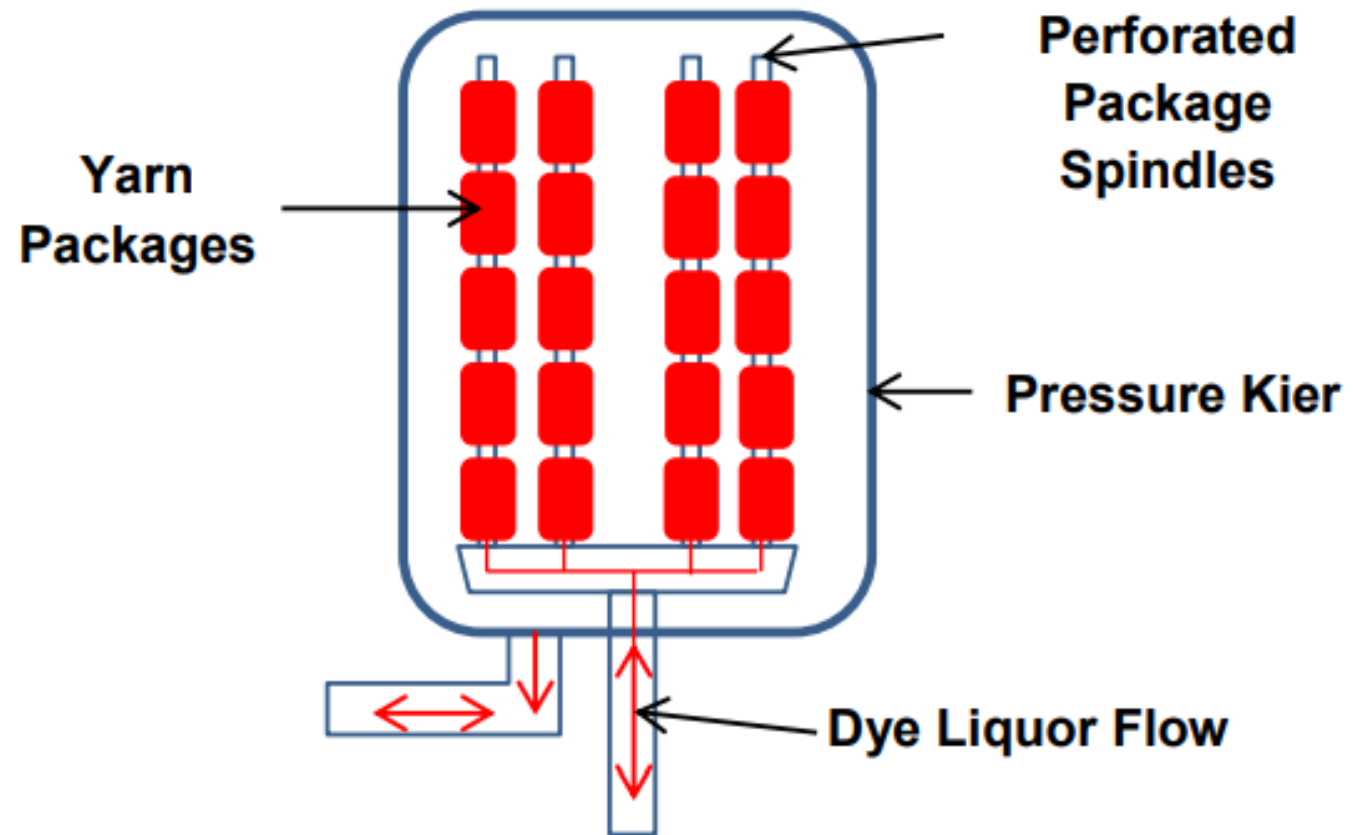


# Yarn dyeing machine - Package dyeing



Photo Credit: Mohammad Abbas Uddin

# Yarn dyeing machine - - Package dyeing



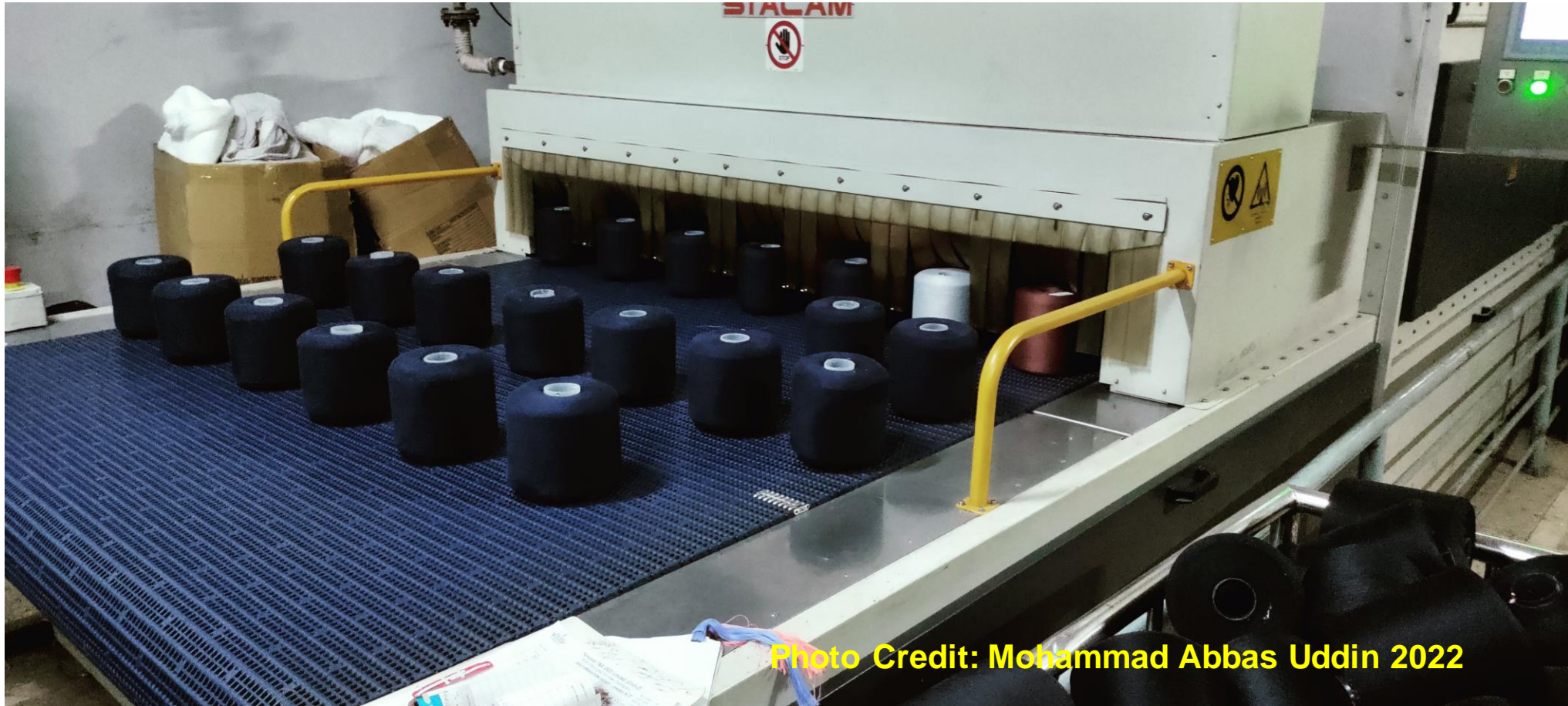
# Yarn dyeing machine - Package dyeing

## Yarn hydroextractor



# Yarn dyeing machine - Package dyeing

RF Drying - In



# Yarn dyeing machine – Package dyeing

RF Drying - Out



Photo Credit: Mohammad Abbas Uddin 2022



# Yarn dyeing machine – Package dyeing

Dyed and Finished package



Photo Credit: Mohammad Abbas Uddin 2022

# Yarn dyeing machine – Package dyeing

Hard winding



Photo Credit: Mohammad Abbas Uddin 2022

# Basic concept of yarn dyeing



Raw yarn



Winding for dyeing



After dyeing



Re-winding for finishing

# Yarn dyeing machine – Package dyeing

Yarn dyeing problem



# Hank dyeing

# Yarn dyeing machine – Hank Dyeing

Hank process before dyeing



# Yarn dyeing machine – Hank Dyeing

Hank process before dyeing



# Yarn dyeing machine – Hank Dyeing

## Hank Dyeing machine



Photo Credit: Mohammad Abbas Uddin 2022



# Yarn dyeing machine - Hank Dyeing

## Hank Hydroextractor



Photo Credit: Mohammad Abbas Uddin 2022

# Yarn dyeing machine – Hank Dyeing

## Hank Drying



# Yarn dyeing machine – Hank Dyeing

Hank to Cone process

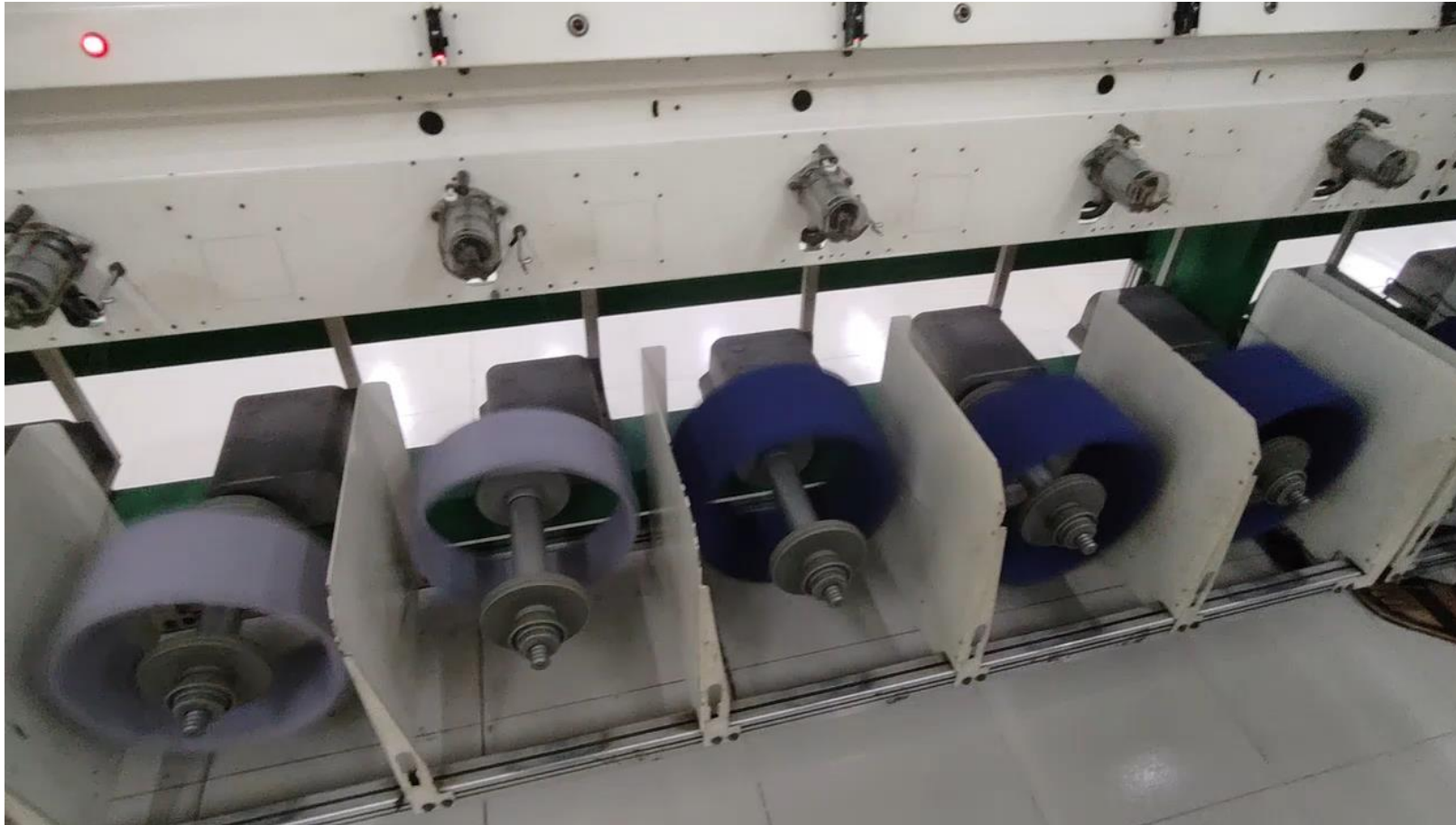


Photo Credit: Mohammad Abbas Uddin 2022

# Tape/Elastic/Lace dyeing

# Yarn dyeing machine – Tape/Elastic/Lace Dyeing

From Padding to Finishing – One machine

Padding – Steaming/Drying – Washing – Finishing- Calendaring



Photo Credit: Mohammad Abbas Uddin 2022

# Yarn dyeing machine – Tape/Elastic/Lace Dyeing

Padding

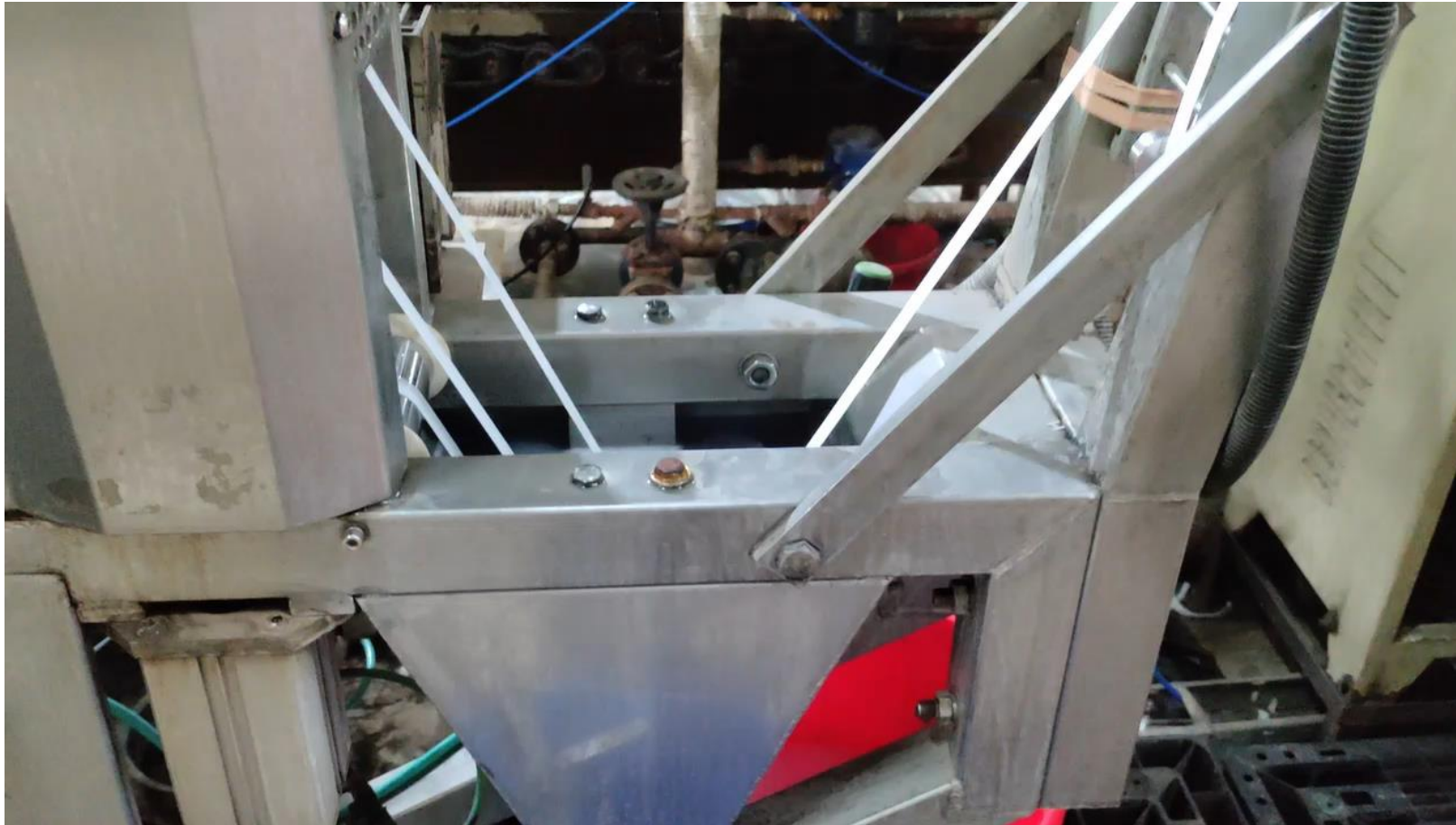


Photo Credit: Mohammad Abbas Uddin 2022

# Yarn dyeing machine – Tape/Elastic/Lace Dyeing

Padding-steaming-washing-finishing



# Yarn dyeing machine – Tape/Elastic/Lace Dyeing

## Steaming and washing chamber



Photo Credit: Mohammad Abbas Uddin 2022



# Yarn dyeing machine – Tape/Elastic/Lace Dyeing

## 8 Washing Chamber



# Yarn dyeing machine – Tape/Elastic/Lace Dyeing

## 8 Washing Chamber



Photo Credit: Mohammad Abbas Uddin 2022

# Yarn dyeing machine – Tape/Elastic/Lace Dyeing

8 Washing Chamber – But not all are used



Photo Credit: Mohammad Abbas Uddin 2022

# Process optimization

# Yarn dyeing – Process optimisation

About 2 hours	About 2 hours	?? Hours, for good fastness
<b>Pretreatment</b>	<b>Dyeing</b>	<b>Washing-Soaping-Rinsing</b>
<p>“ Chemical” time. due to Substrate Chemical system</p> <p>Almost fixed</p> <p>About 20% of total water and energy</p>	<p>“ Chemical” time. Due to dyestuffs.</p> <p>Almost Fixed</p> <p>About 10% of total water and energy</p>	<p>“ Physical” time. Also due to machine efficiency.</p> <p>Widely Variable</p> <p>About 70% of total water and energy</p>

# Yarn dyeing – Process optimisation

- Dyeing machine efficiency
  - ✓ Optimized flow-rate
  - ✓ Intensive exchange dyeing-rinsing liquor / material
- Washing performance
  - ✓ Optimised rinsing
  - ✓ High-efficiency wash-out and soaping

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