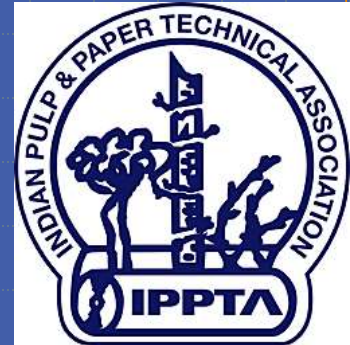


# **Paper Machines: Approach Flow, Paper Manufacturing Basics, Press Sections and Drying**

By-

**D K Singhal**

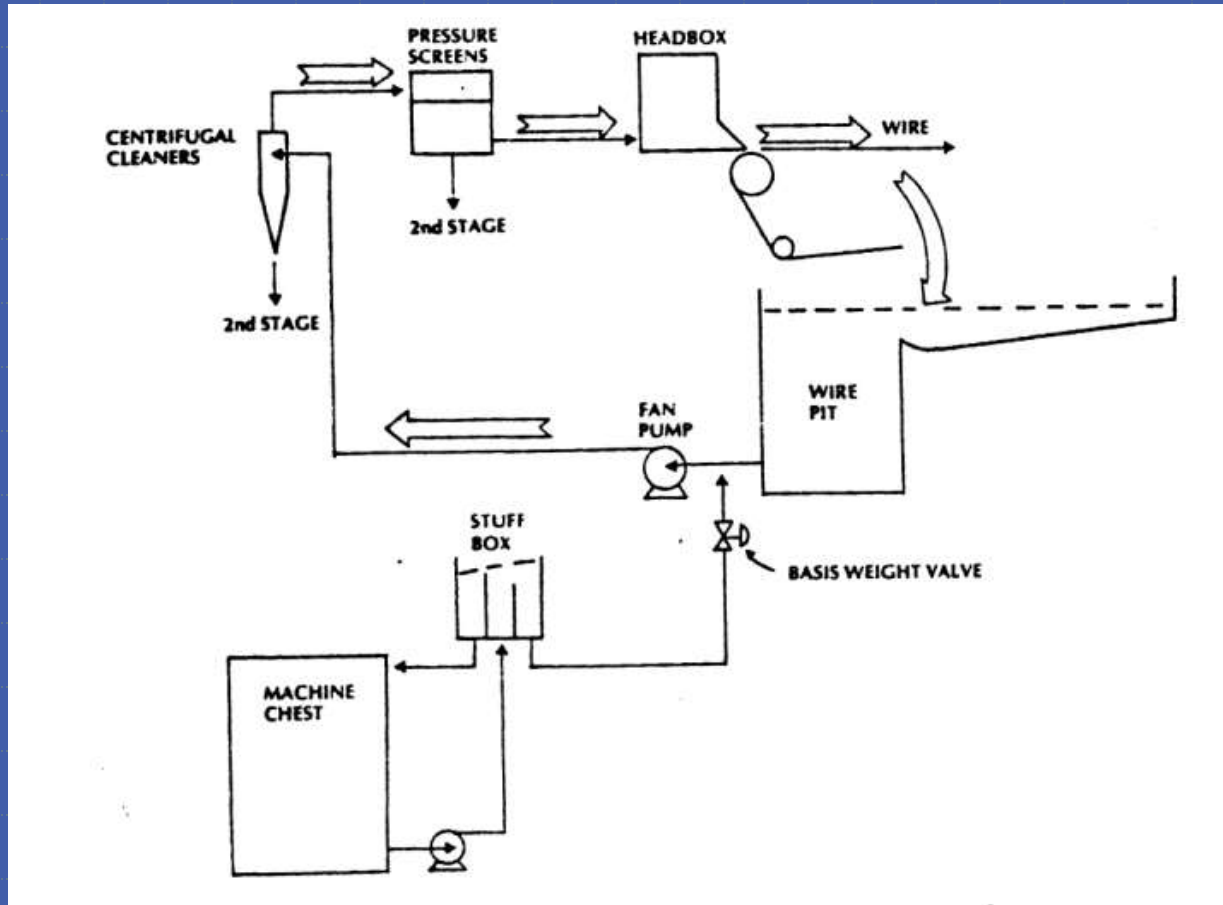
February 19, 2019



# Approach Flow

- **To** dose exactly and mix uniformly all the different components of the final suspension to be delivered to the paper machine.
- **To** supply a continuous suspension flow of constant consistency, quality and flow rate at constant pressure to the headbox of the paper machine.

# Approach Flow



# Key Approaches

- ◆ Constant metering/proportioning
- ◆ Uniform, effective mixing
- ◆ Constant feeding

# Key Elements

S R Box

Basis Weight Valve

Fan Pump/PCC Feed Pump

Centricleaner

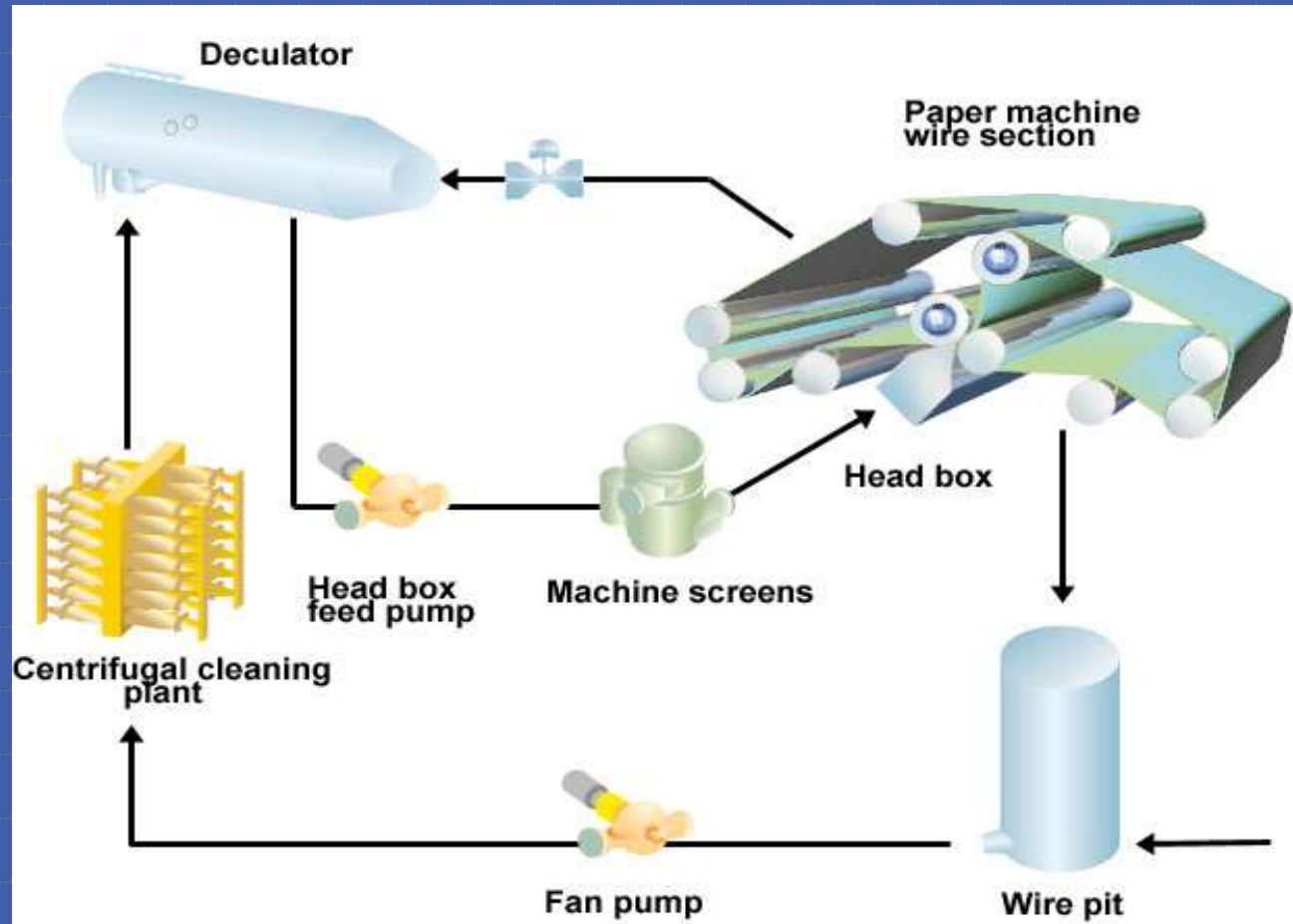
Deculator

Fan Pump/Head Box Feed Pump

Screen

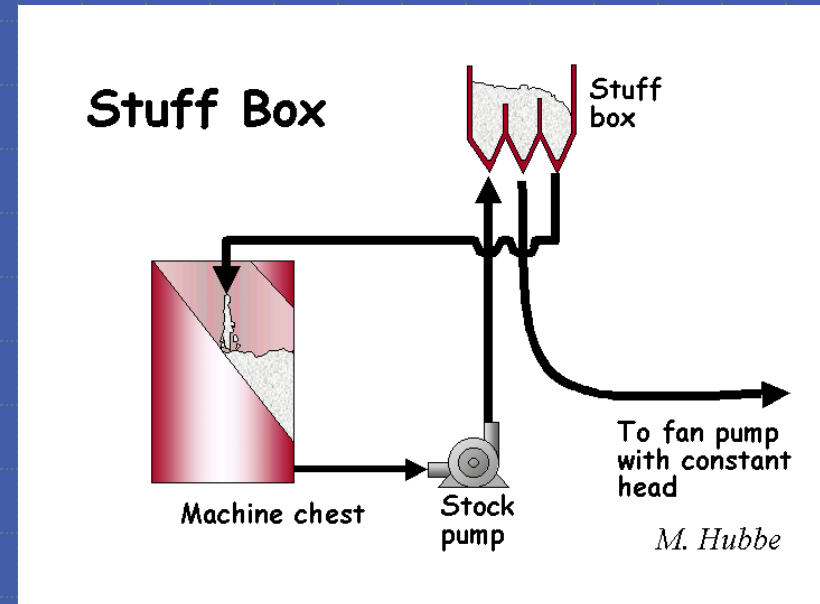
Manifold

# Approach Flow



# S R Box

To regulate the flow to paper machine  
VFD controlled pump and control valve with magnetic  
flowmeter sensing.



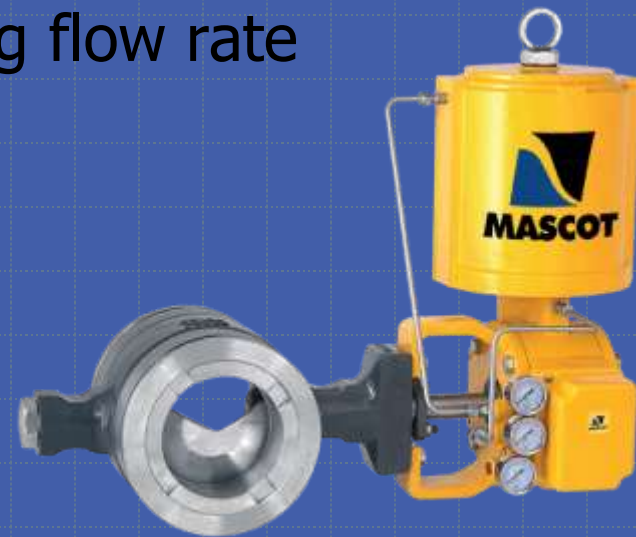
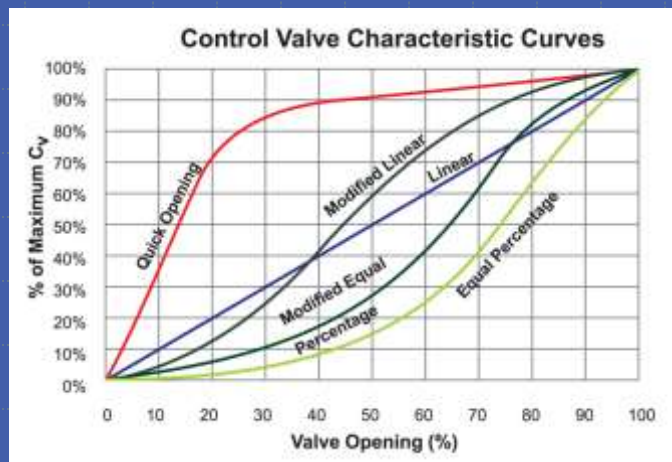
# Basis Weight Valve

To control flow rate

Good Flow Control characteristics

V-Notch Ball Valve

May be automated by sensing flow rate





# Fan Pump

Why such name?  
Pulsation free



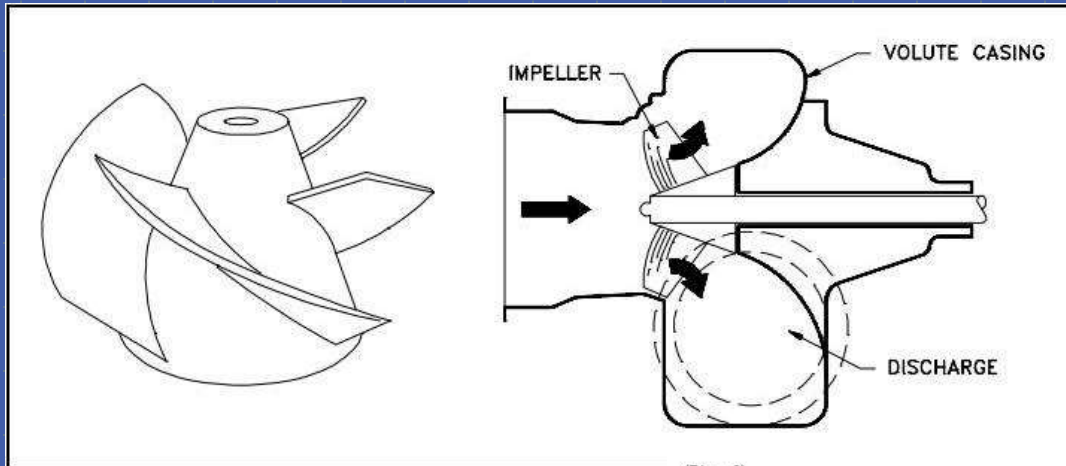
Open Impeller



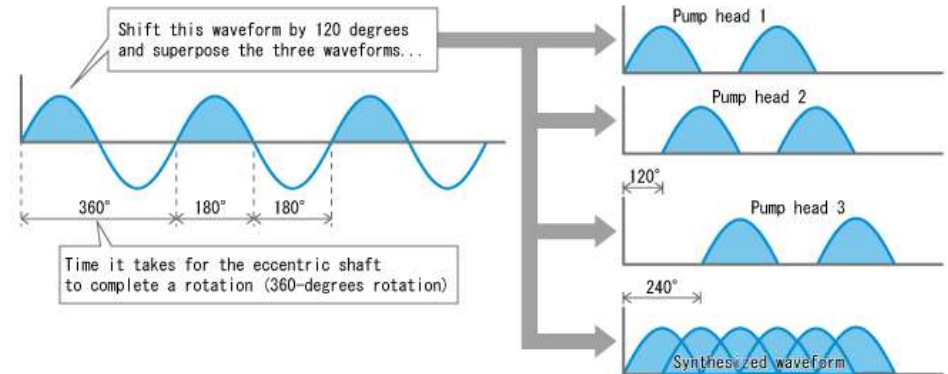
Closed Impeller

or, Mixed flow impeller

# Fan Pump Impeller

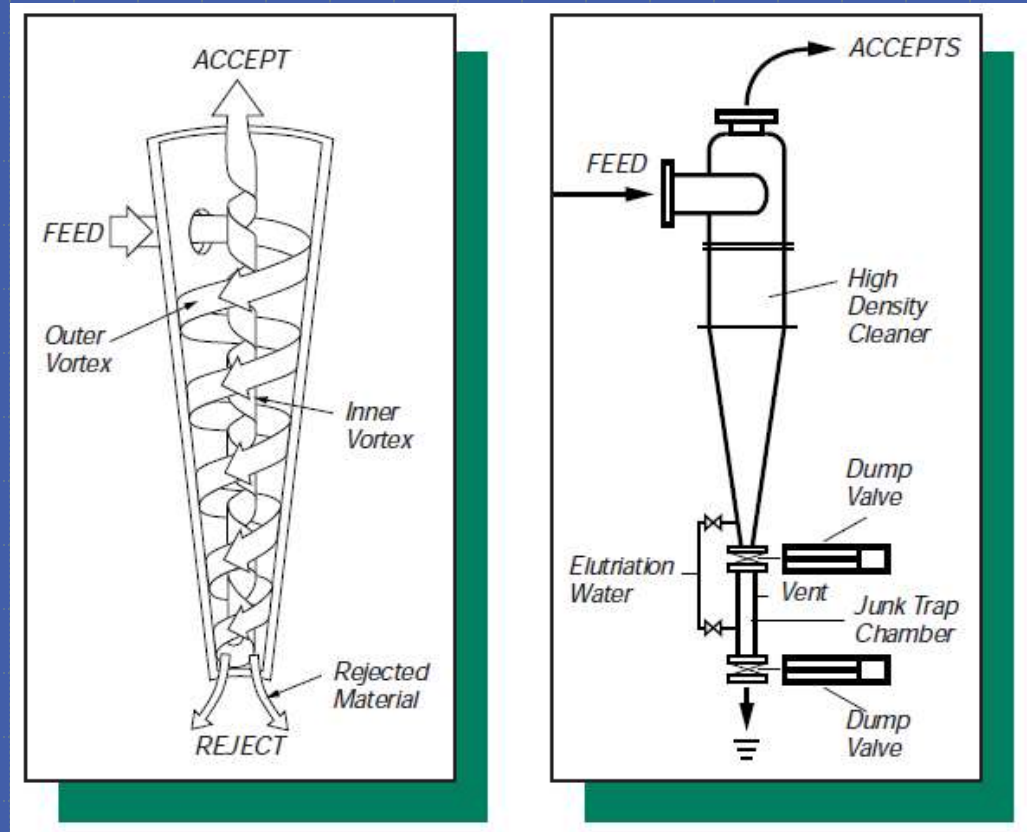


(Fig. 2)



# Centricleaner

Cleaning by  
Centrifugal Action



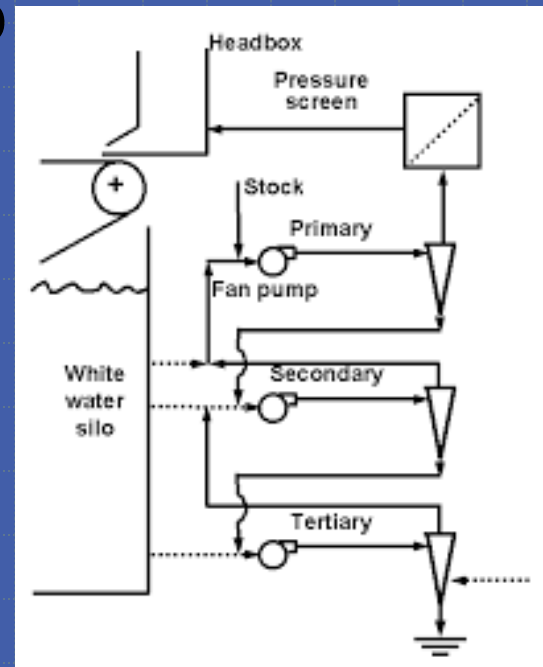
# Centricleaner

Cleaning by centrifugal action

Bigger, heavier particles removed from bottom

Smaller, lightweight particles from top

3, 4 or 5 stage

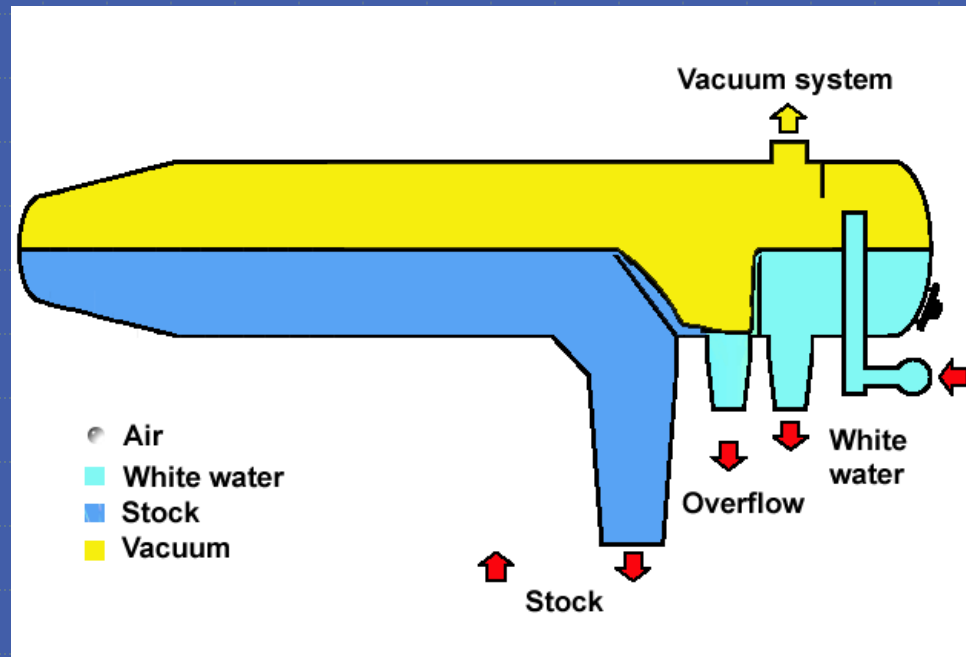


# Deculator

To remove excess air in pulp

Why to remove

How to remove



# Fan Pump

Again?

Double Dilution.

Why double dilution?

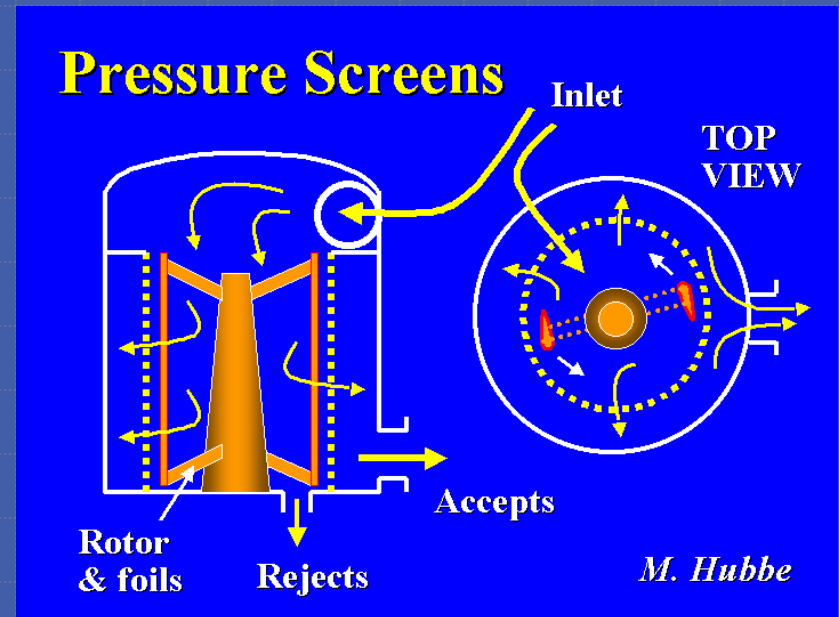
# Screening

Why screening

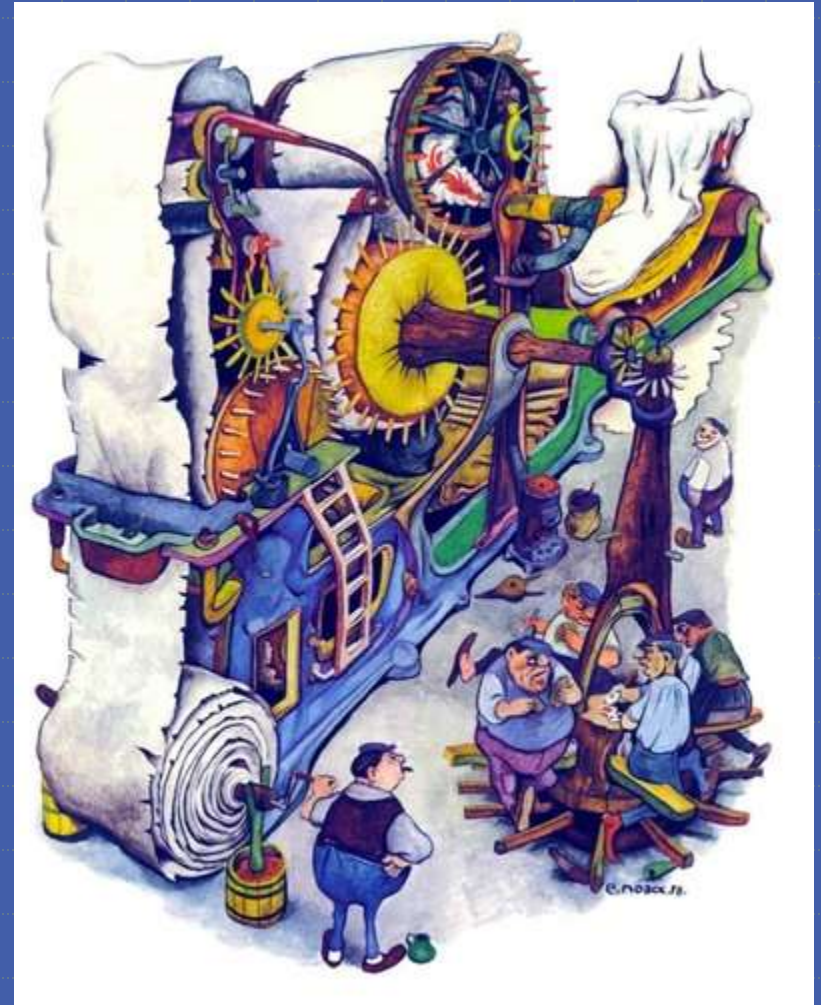
What to look in designing screening system

2 or 3 stage screening

Cascading



# Paper Machine



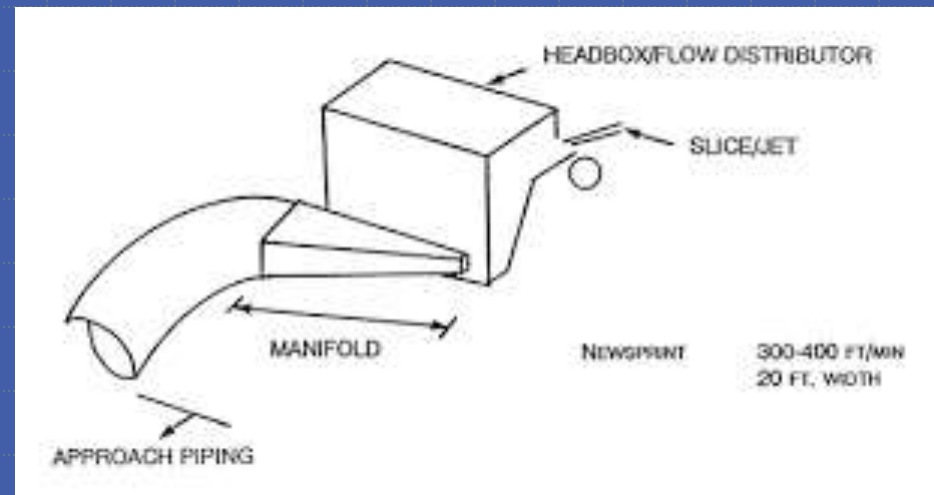


# Manifold

Part of headbox or part of approach flow

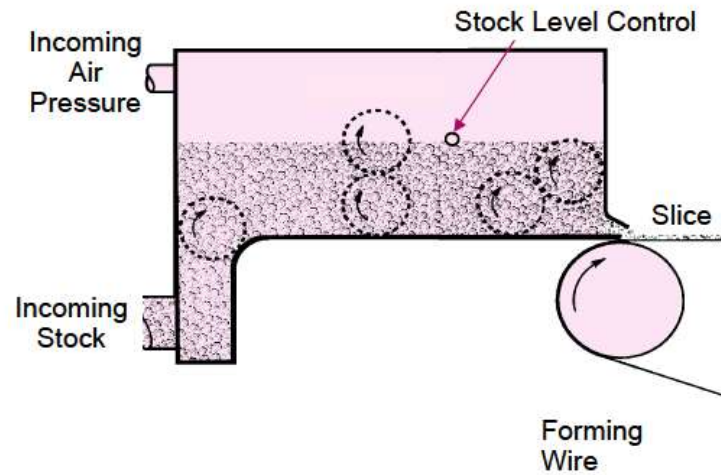
Pulp enters from a circular pipe

Has to be distributed evenly throughout the deckle



# Head Box

## Schematic



# Headbox

Pulp enters from a circular pipe

Needed to spread on full width of wire

Uniform spreading

Turbulence generation to have a good formation

# Getting Good Results

- ◆ No surging of feed entering the Headbox
- ◆ No dead (no flow) areas inside the Headbox
- ◆ No sharp internal corners or edges to catch the stock
- ◆ Maintain a uniform fiber dispersion
- ◆ Eliminate entrained air
- ◆ Distribute stock uniformly across the full width of the machine

# Headbox: Open/Close

Open Headbox

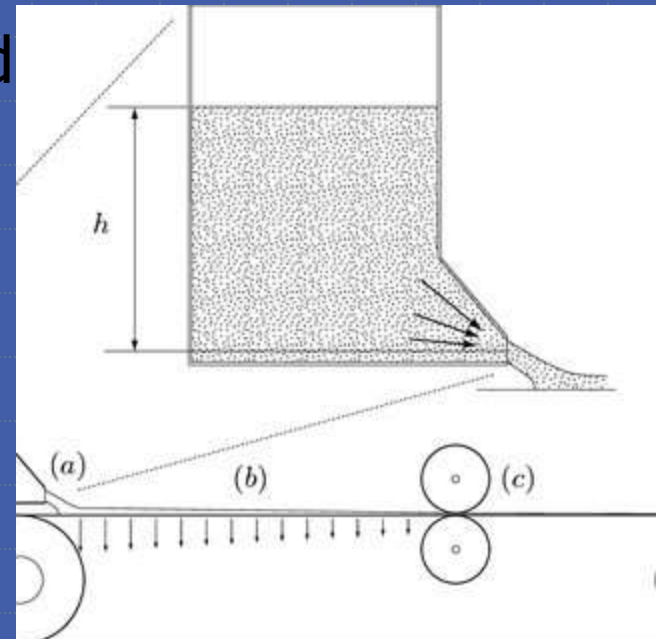
Jet/Wire Ratio

Head:  $v^2=2gH$

High machine speed  $\sim$  high head

Troubles with High Head

Pressurized Headbox

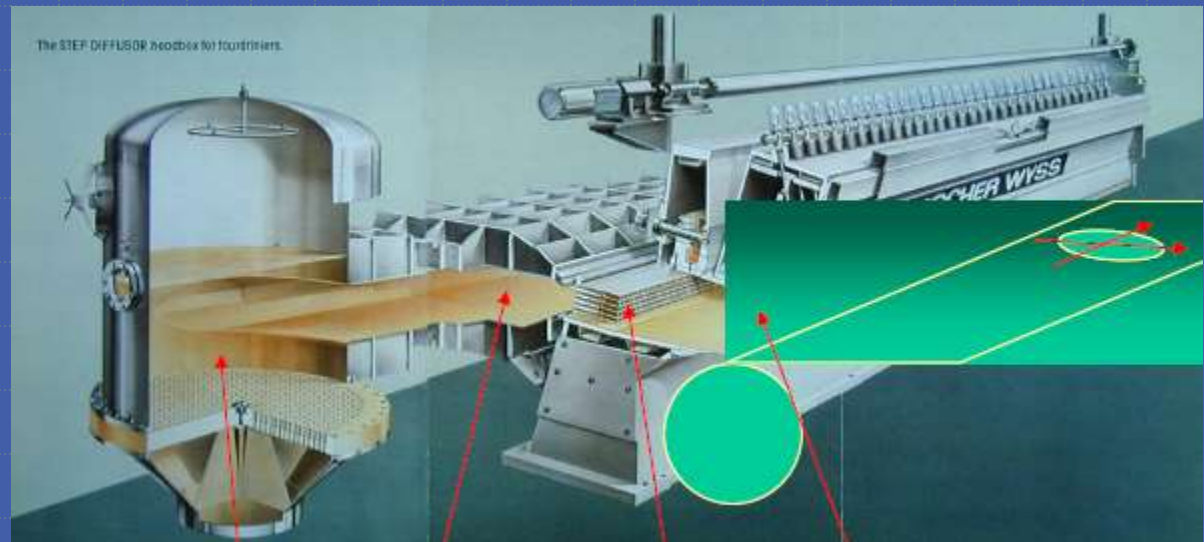


# Headbox

Pressurized Headbox

Air Cushion Headbox

Hydraulic Headbox



# Wire Table

To allow dewatering maintaining desired properties

Formation

GSM control

Strength

Inter-fiber bonding

Two-sidedness

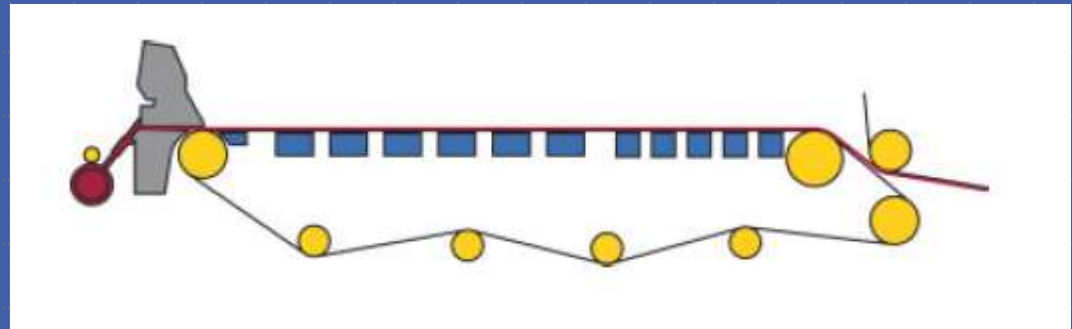
Better retention

Better dryness



# Wire

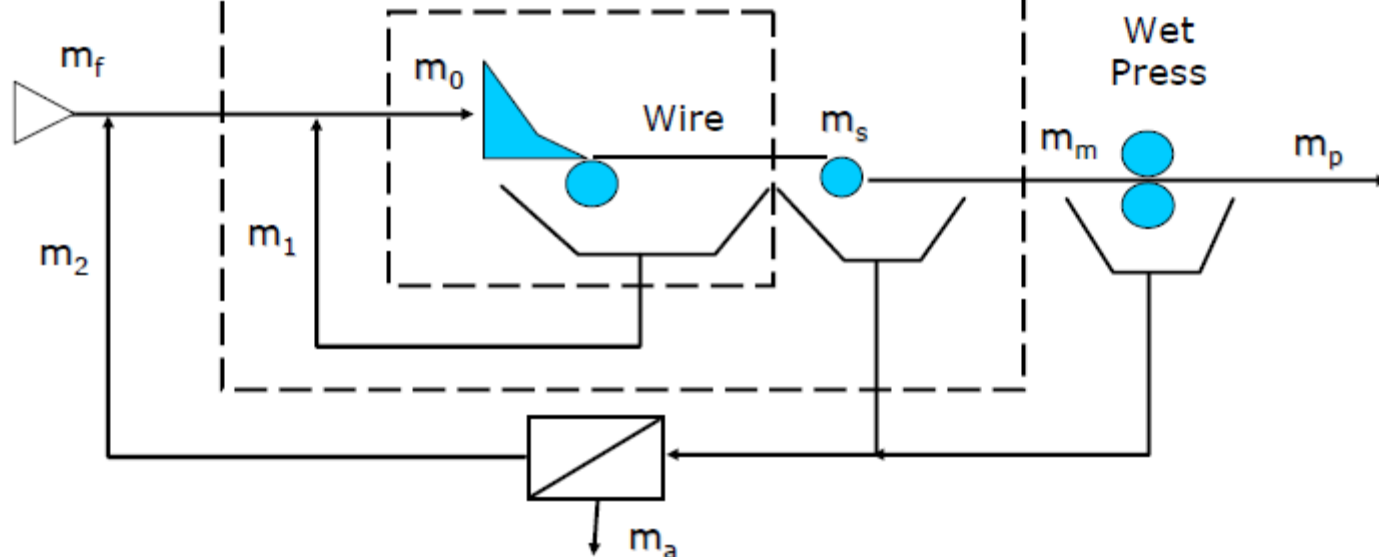
An endless wire mesh to hold pulp, allow the water from it to drain easily by gravity, vacuum and/or pressing.





# Retention

## Concepts of Retention



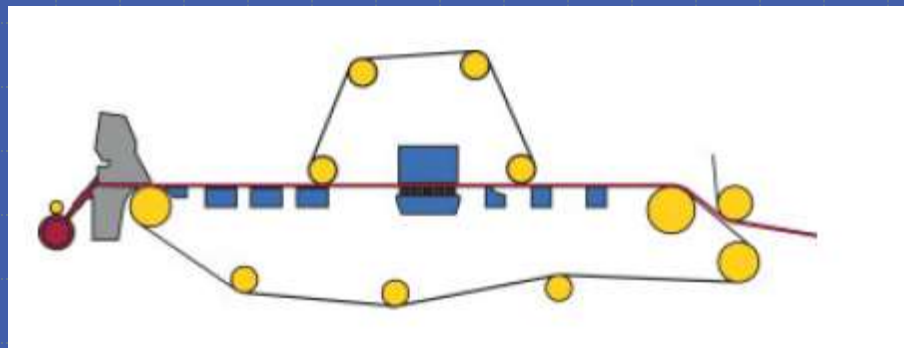
1. Wire Retention =  $m_s/m_0$
2. Machine Retention =  $m_m/(m_0-m_1)$
3. System Retention =  $m_p/m_f$

# First Pass Retention

$$\text{FPR (\%)} = \frac{\text{HBcons (\%)} - \text{WWcons (\%)}}{\text{HBcons (\%)}} * 100$$

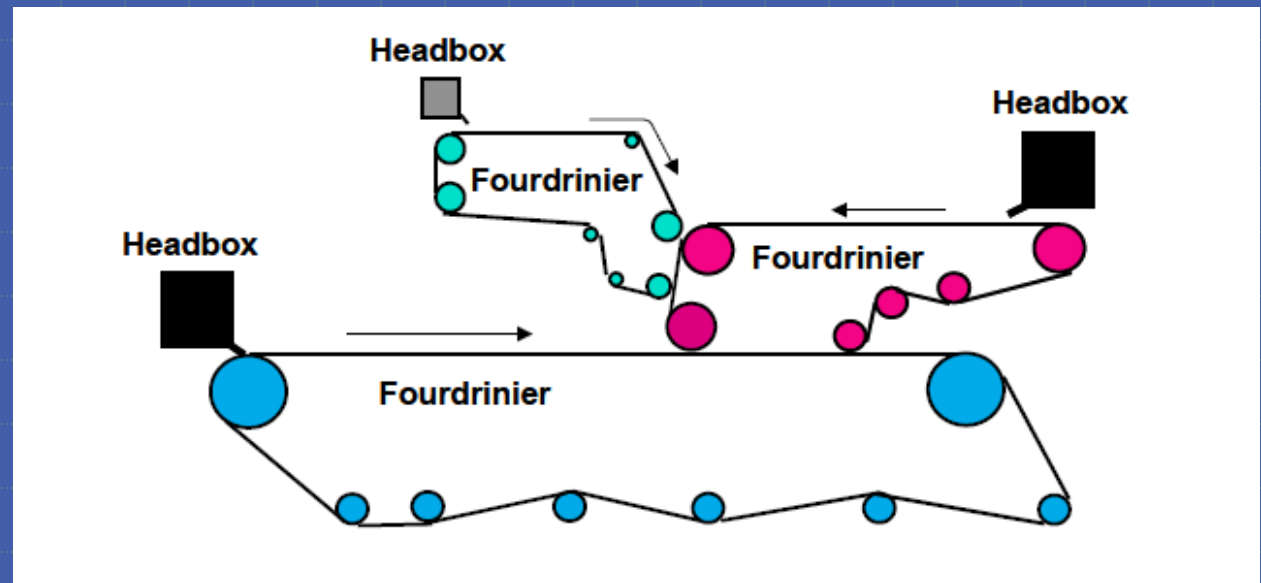
# Wire Table

Use of Dandy  
Double wire



# Wire Table

For Multi-Layer Paper and Board



# Wire Part

Dewatering at wire part by

Gravity

Mild Vacuum

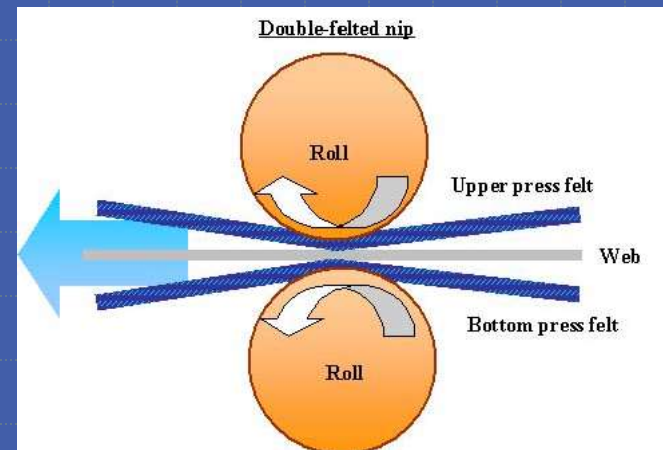
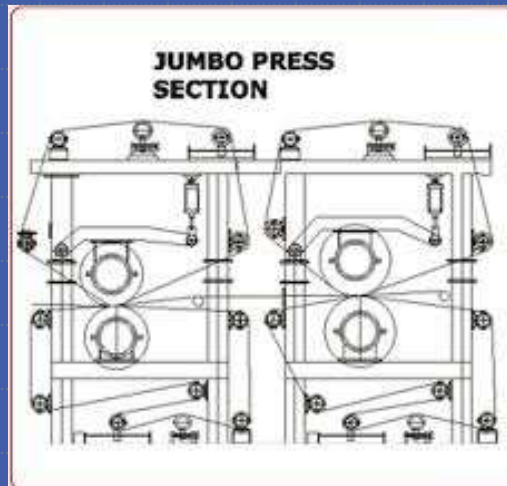
Dandy/ top wire

Higher Vacuum

How to dewater more?

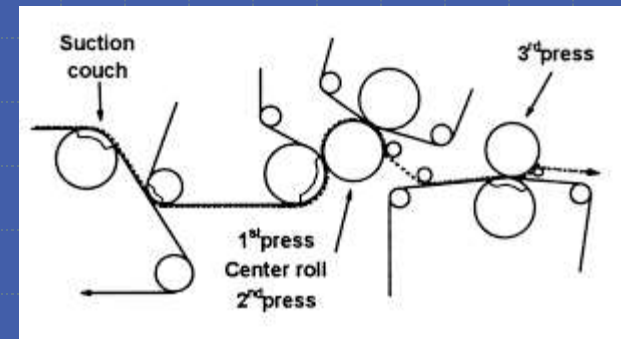
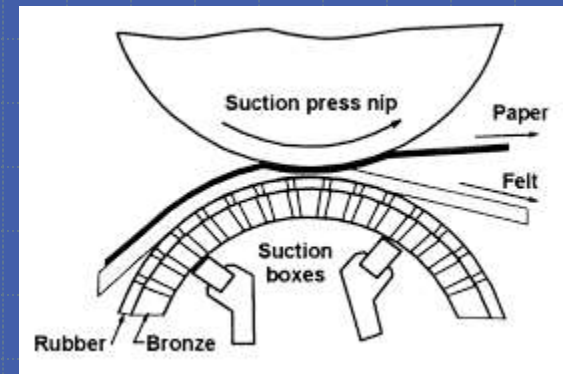
# Press Section

Squeeze the wet web of paper  
Pressing- gently or with force?  
Pressing- Single or multi-stage

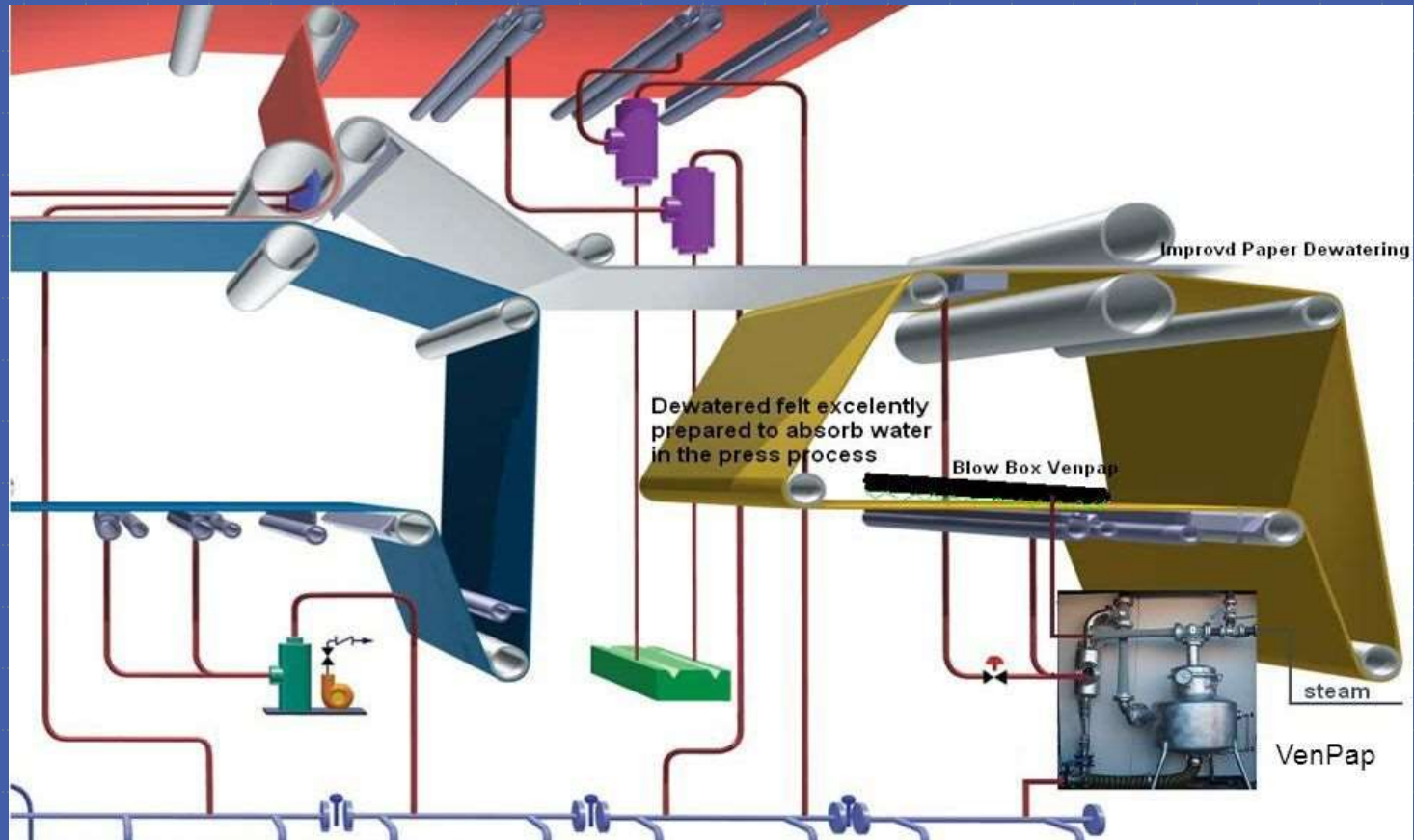


# Press Sections

- ◆ Straight Through Press
- ◆ Double Felted Press
- ◆ Inverted Press
- ◆ Jumbo Press
- ◆ Bi-Nip Press
- ◆ Tri-Nip Press
- ◆ Shoe Press
- ◆ Suction Press



# Felt Conditioning





# Vacuum Pump

To generate vacuum

Low vacuum- Centrifugal blower

Turbine blower

Roots Blower

Water Ring Vacuum Pump

Oil Ring Vacuum Pump

Capacity- air flow

Capacity- gauge vacuum level

# Dryer Section

To dry the paper by thermal heat application

Conventional- Contact drying

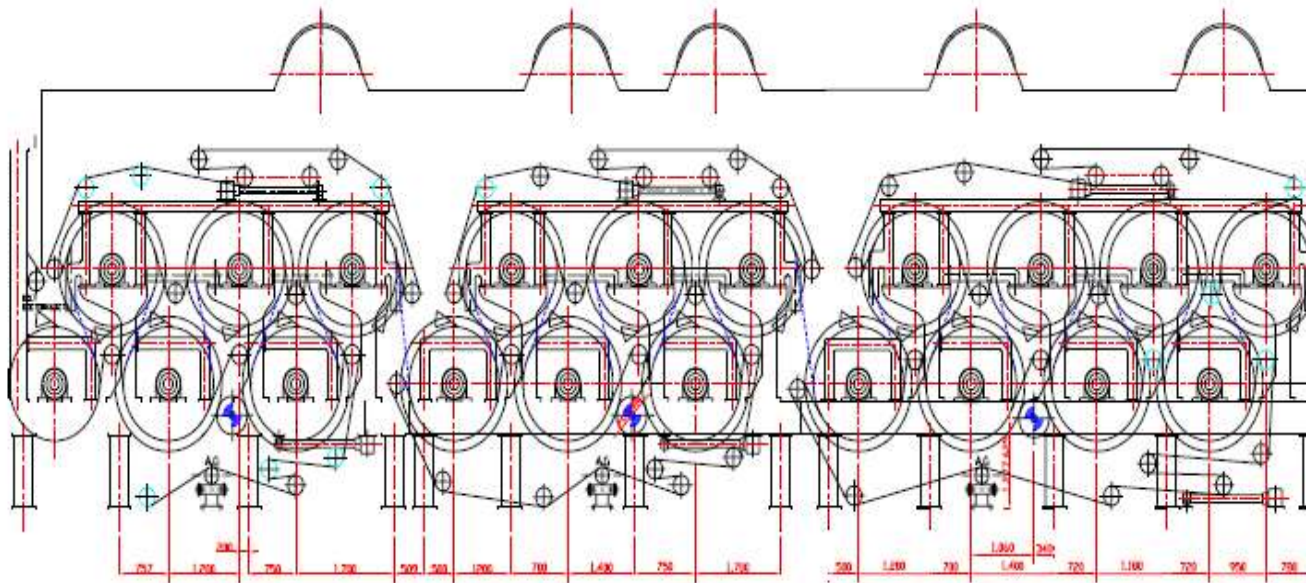
Extensions- Hot Air impingement (Hood)

Extensions- IR Drying

# Typical Dryer Part

## Dryer Part

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# Dryer

Material of construction

Diameter

Increasing drying rate

Pocket ventilation

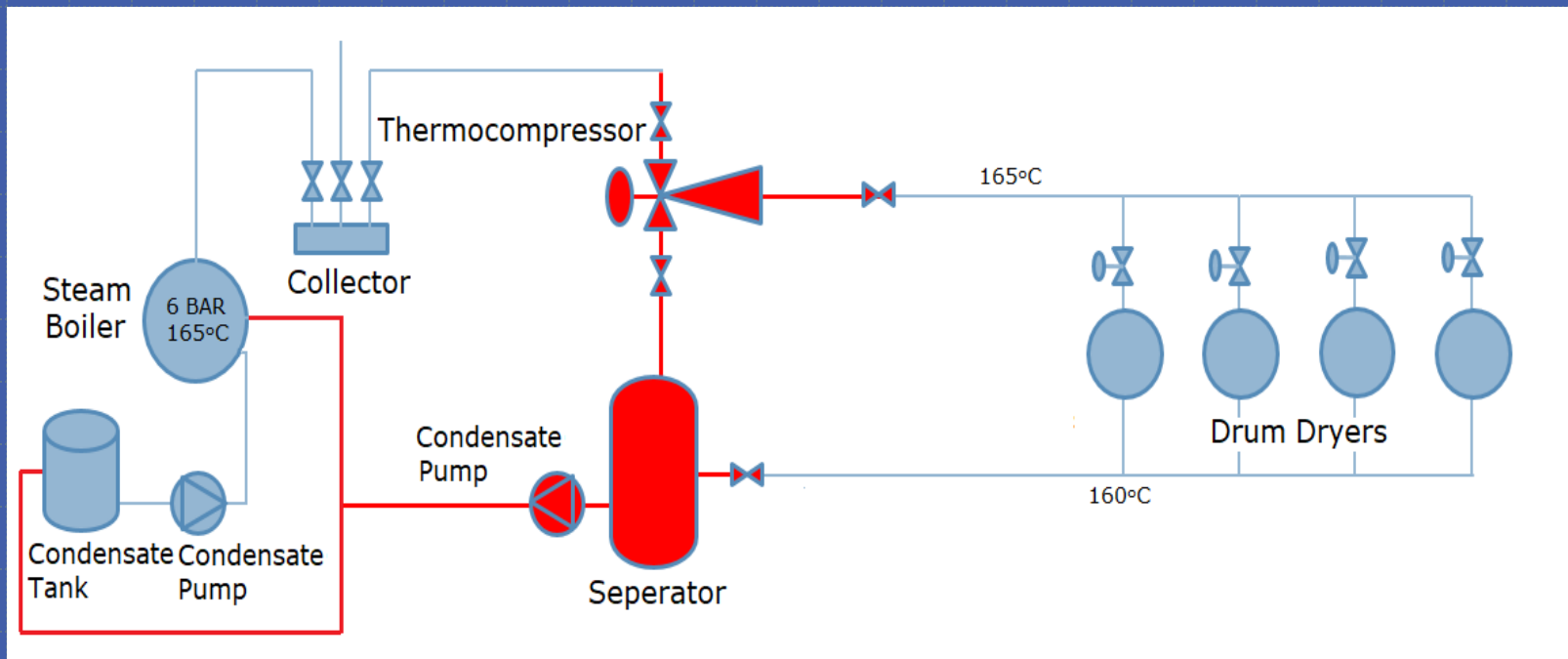
Dryer screening

# Yankee Dryer

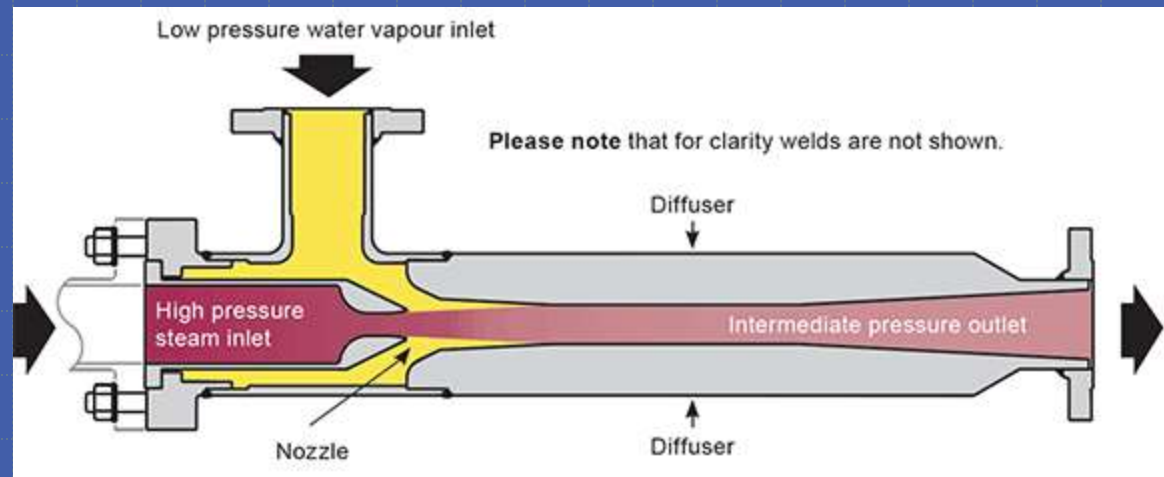
Large diameter  
Single side heating  
One side glaze (MG)



# Condensate Management

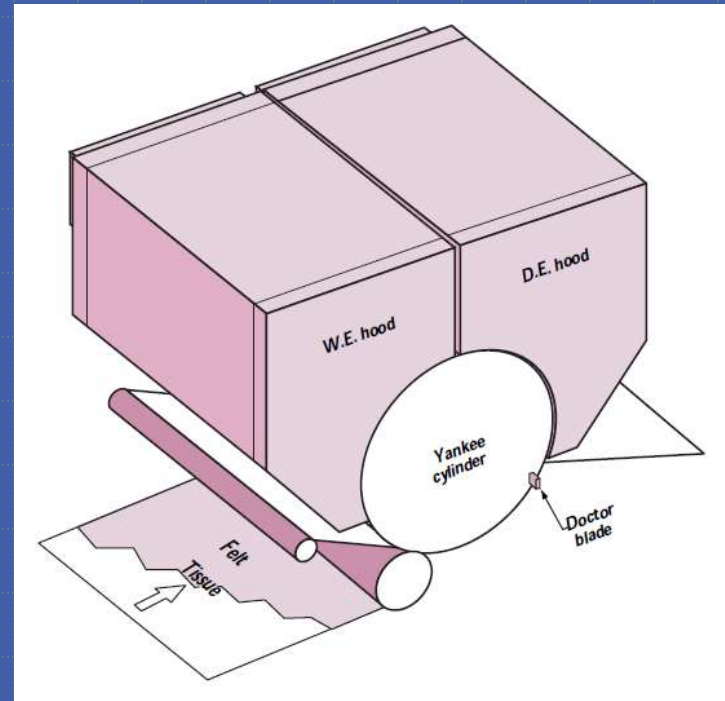


# Thermocompressor



# Hood

- To impinge hot air
- To remove moist air
- To increase production rates
- To reduce energy consumption





# Calendering

Paper web is run between in order to further smooth it out, which also gives it a more uniform thickness.



# Calendering

Objectives-

Caliper variation control

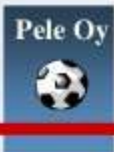
Improvement in surface smoothness

Improving printability

Reduced two sidedness

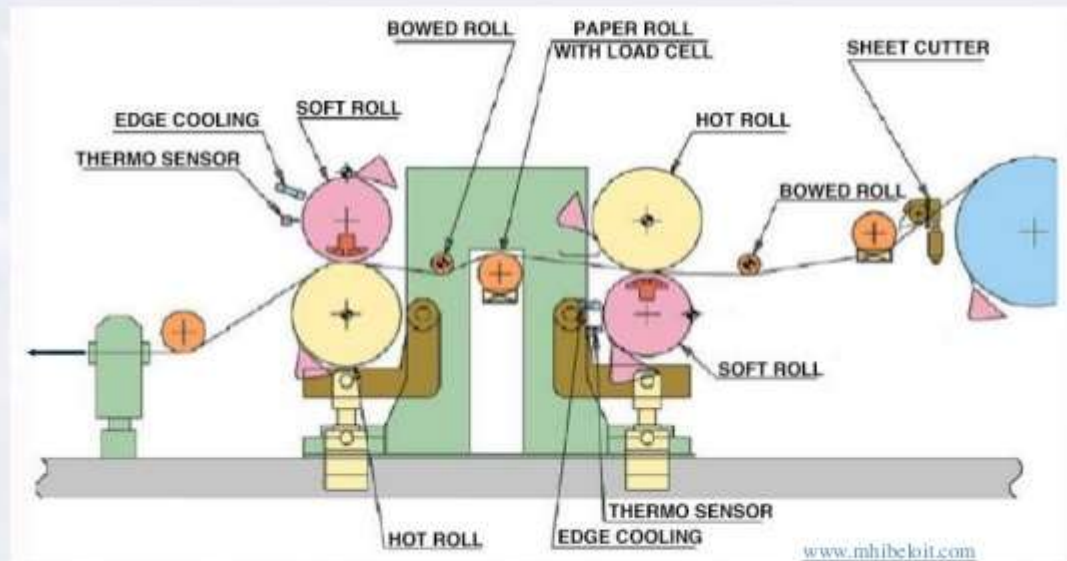
# Soft Nip Calendering

Tha



## Two-nip soft calender

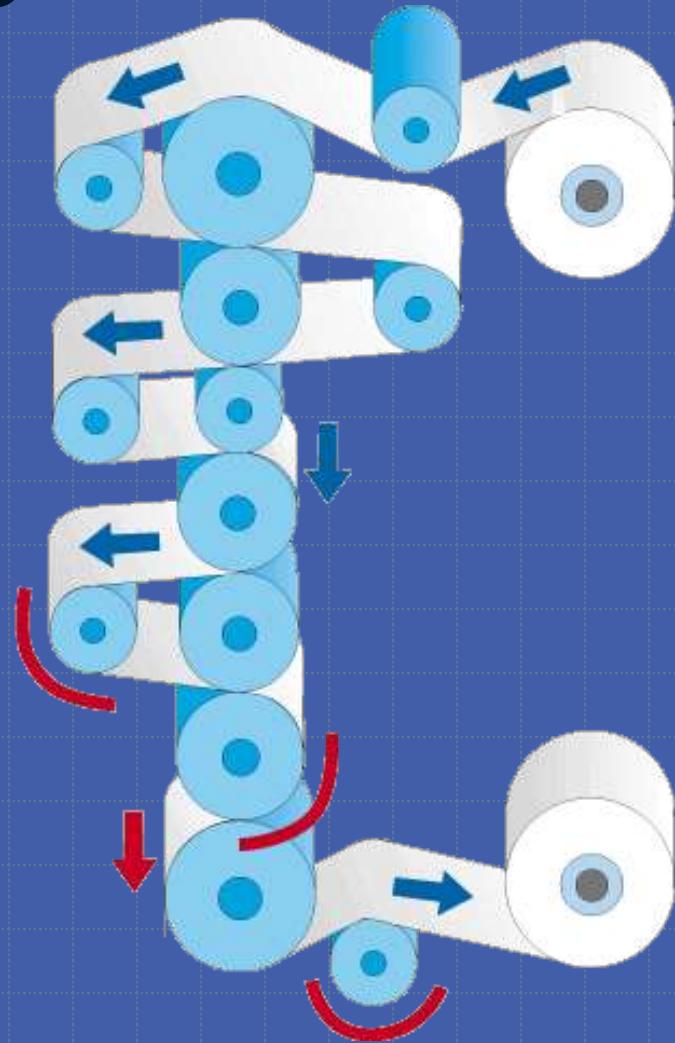
- This kind of soft calender is typical for copy and other uncoated woodfree papers. Sometimes only one nip is needed, if base paper is not symmetrical.



[www.mhfbcl.it.com](http://www.mhfbcl.it.com)

# Supercalendering

For better gloss  
Better smoothness of paper  
Better printability





# Questions?



**Thank You.**