CHALLENGES

when creating a fiber mat

• Control the fiber formation
• Having the right fiber consistency and water flow
• Finding the ideal fan pump configuration
• Keep the fibers well dispersed up to the former
• Laying fibers with the right fiber orientation and well distributed on the wire
• Keep the web forming process stable
WETLAID FORMING OF A WEB WITH FIBERS

White water loop of a inclined wire former
WETLAID FORMING OF A WEB WITH FIBERS

What is good formation?

- Most fibers in water have a tendency to agglomerate and build up flocs
- Small flocs are necessary to form a sheet on the wire
- Larger flocs appears as clouds in the formed web

How good the formation highly depends on the product requirements

Quality Level should not fluctuate
WETLAID FORMING OF A WEB WITH FIBERS

How can formation be influenced?

Three design points are essential
1. Give the fibers enough room to move freely around in the water-fiber suspension
2. Bring enough turbulence in the water-fiber suspension. Keep the fibers moving.
3. Lay the fibers in the best fiber orientation and good distributed on the wire

Chemicals can be added to slow down the floc building
• Viscosity modifiers: more resistance from the fluid and slow down agglomeration to flocs
  => Consequence: More dispersing energy is needed
• Surfactants: Reduction of force by which the fibers agglomerate
  => Consequence: To be minimized due to associated foam formation!

Wet end design of a fiber glass mat wetlaid line has a significant impact on the forming process. Applying best design can limit the dependency on white water viscosity and surfactant chemicals.
# Chapter Overview

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**Consistency** = weight-% of solids in the fiber slurry, AKA “solids”

- The longer the fiber, the lower the consistency need to be.
- The lower the consistency, the higher the flow in the white water loop at a constant line throughput.
- The capacity of the former and fan pump will be defined by: consistency, line speed, base weight and forming width.

**The former & the fan pump should be able to handle the large flow!**
Key figures for a centrifugal pump: Head

- **(Total) Head**: The pressure difference between the discharge and suction side of the pump
- It consists of:
  - **Static head** (height difference between level on suction side and discharge side)
  - **Vacuum** in the white water return tank
  - **Friction head** (friction losses, caused by the flow of the fluid)

Friction head is based on assumptions because of the operating range diversity of a line, chemicals usage and associated complex calculations.

The range of real total head value of an inclined wire former requires **design slack**
GIVE THE FIBERS ROOM - PUMP CURVES

The Q-H curve (Q=Flow; H=Head)

- Underload area
- Optimal operation window
- Overload area
- Design operating points
- Lines of constant efficiency
- Lines of constant rpm
- Flow (Q)
• **NPSHa**: Net Positive Suction Head available (at the suction flange of the pump) is the Absolute Pressure head minus the Vapor Pressure of the liquid.

• **NPSAa** is the result of a process design. An important influencer is the level above the suction flange.

• **NPSHr**: NPSA required and is directly linked to the pump design.

• **Cavitation** occurs if NPSHa < NPSHr. Under low pressure conditions, the liquid turns in vapor bubbles. The bubbles implode when the pressure increases. Those implosions cause damage to the suction side of the impeller.
The NPSHr curve

- The NPSHr curves are giving the NPSHr for each constant RPM line
- Optimal operating points for NPSHr are in the most horizontal part of the curve
Uncertainties in the head calculations can lead to NPSH problems

**Pump 1**
- Seems to be the right choice. There is even room for future flow increase.
- But if in reality the head is significantly lower, the pump is already running close to overload area and there is no room for future flow increase.

**Pump 2**
- Is running in underload at the original design point, but can be used.
- If the real head is lower, the pump is running in the preferred operating window, the future flow will be the optimum.
Low pulse - double suction – split case pumps

**Take away:**

For a reliable and long-term fan pump choice ensure **Design Slack**: pump shall be able to handle theoretical and future head and flow:

Is the position of the pump low enough to ensure $\text{NPSHa} > \text{NPSHr}$?

Too small pumps and shallow basement are suspicious!
Mixing fibers in white water: Flocs but no clumps...

Mixing glass fibers in white water is:
- Depending of the fiber length and diameter
- Depending of the fiber finish
- Depending of the white water chemicals
- Depending of the residence time in the mix and store chests

Testing of glass fiber dispersing in specialized technology centers is highly recommended before choosing the type of mixers and stock prep configuration!
For most glass fibers, dosing fibers in one step to the final thick stock consistency is not the optimal solution.

Beside suboptimal dispersing, there is no possibility to adjust fiber dosing fluctuations/errors.
**Mixing on higher consistency.** This is very often more efficient.

**Extra dilution step** can reduce consequences of fiber feed dosing errors.
Decoupling of functions

- **Pre diffusor** for changing flow in header from cross machine direction in machine direction

- **Main diffusor** optimized for optimal turbulence: Defloccing
DISPERSING – KEEP THE FIBERS MOVING

Double diffusor => More DISPERSING ENERGY

Fluid speeds double diffusor

Two peaks

Fluid speeds single diffusor

One peak
FORMING THE WEB – GOOD FIBER LAYING

Guiding of the slurry flow to the wire
Control factors for forming process

- Wire speed
- Speed of the slurry
- Gap 1
- Gap 2
- HB Pressure
- Flow
- Flow control valves
- Flow transmitters
- Vacuum
- Overflow
- To fan pump
FORMING THE WEB – GOOD FIBER LAYING

Even dewatering in Machine Direction and Cross Machine Direction

Near Former Inlet

Near Former Middle

Near Former Outlet
FORMING THE WEB—GOOD FIBER LAYING

A combination between the materials, the process and the machine

An optimized machine and process design:

- Reduce the dependency of excipients as viscosity modifier and dispersants
- Reduce operating costs
- Improve formation Quality
CHAPTER OVERVIEW

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