NONWOVEN

# HOW TO FORM A GLASS FIBER MAT?

## DESIGN CONSIDERATIONS

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TAPPI FIBERGLASS COMMITTEE MEETING SEPTEMBER 2019

ANDRITZ

ENGINEERED SUCCESS

# CHALLENGES

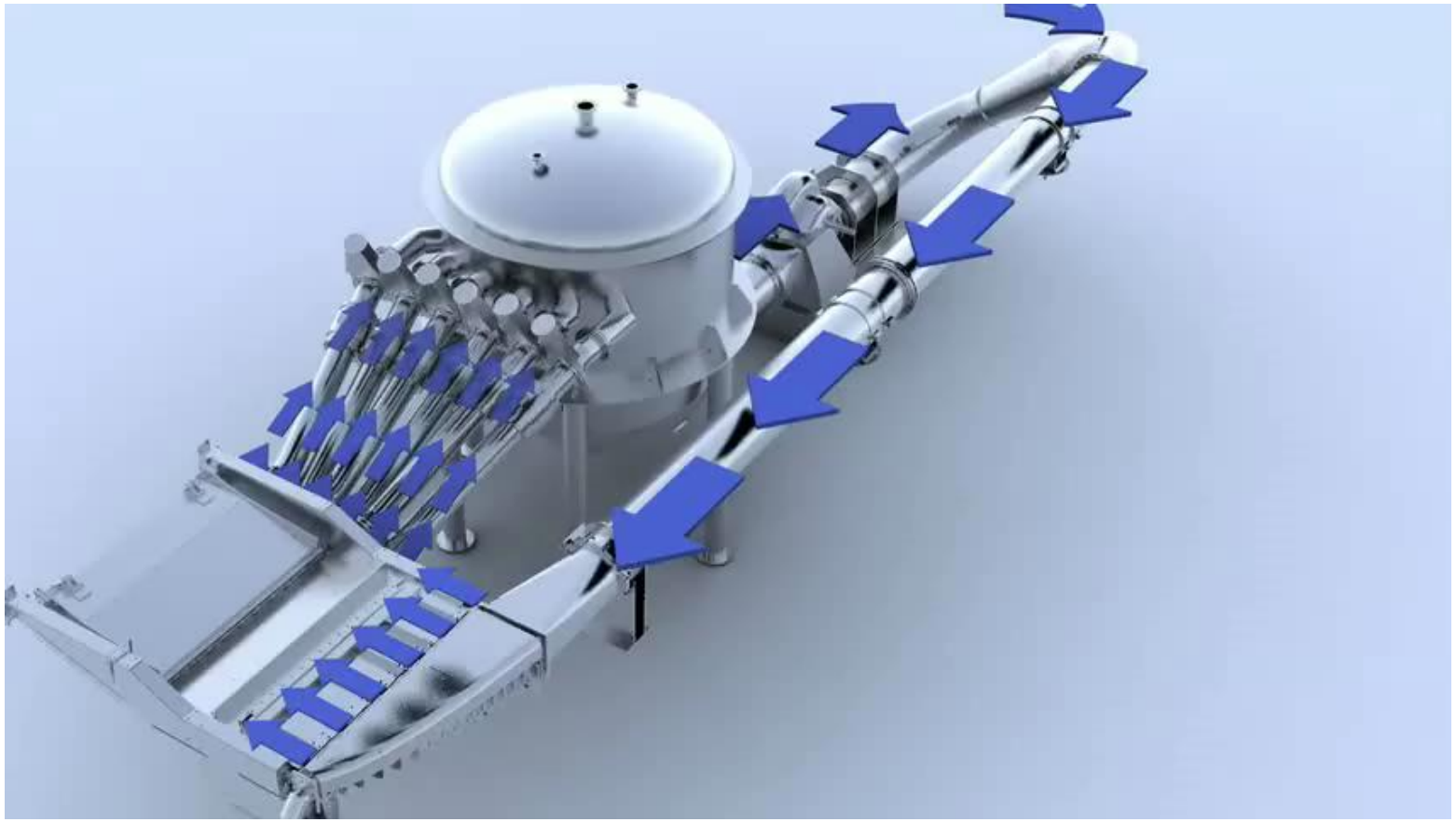
## when creating a fiber mat

- 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 stabile

# CHAPTER OVERVIEW

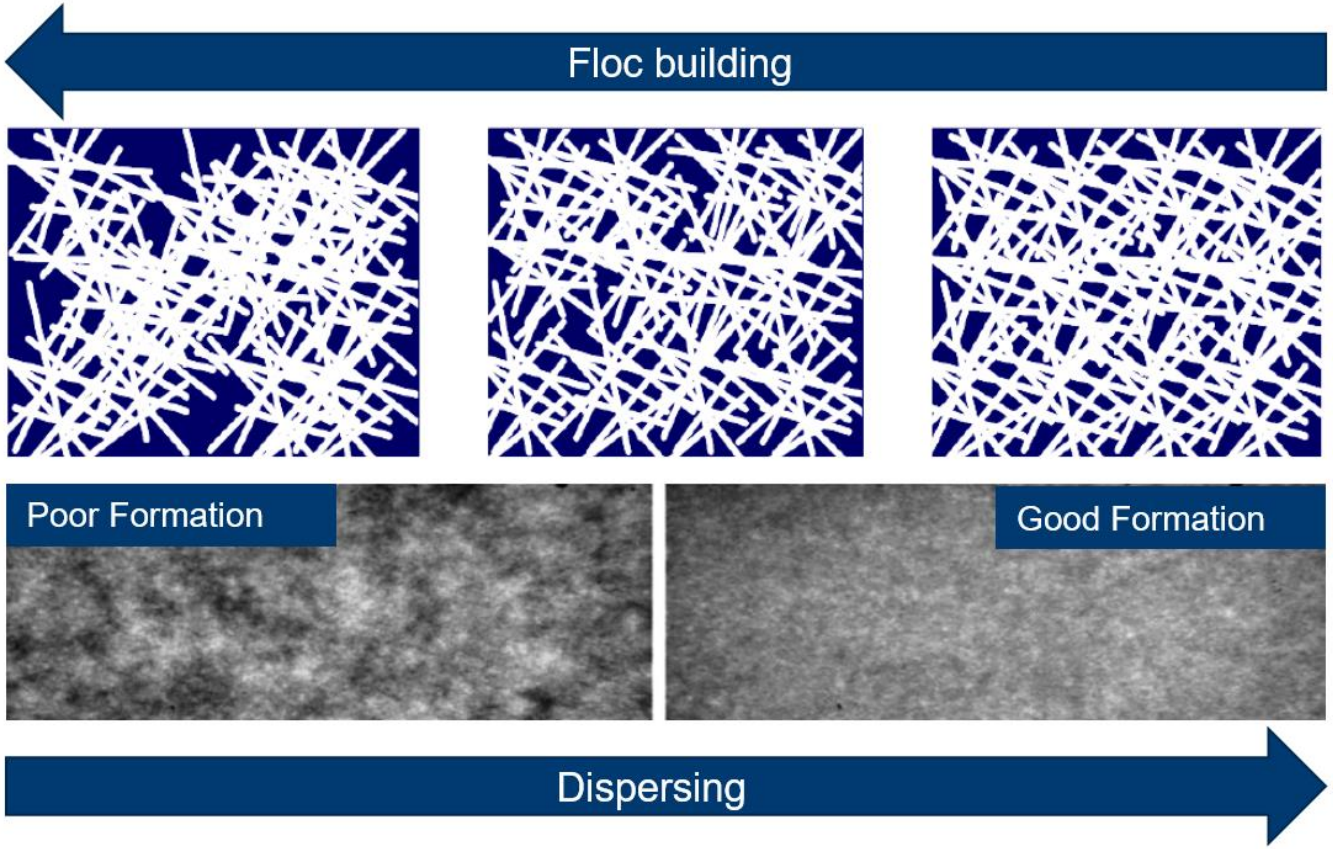
# WETLAID FORMING OF A WEB WITH FIBERS

## 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**

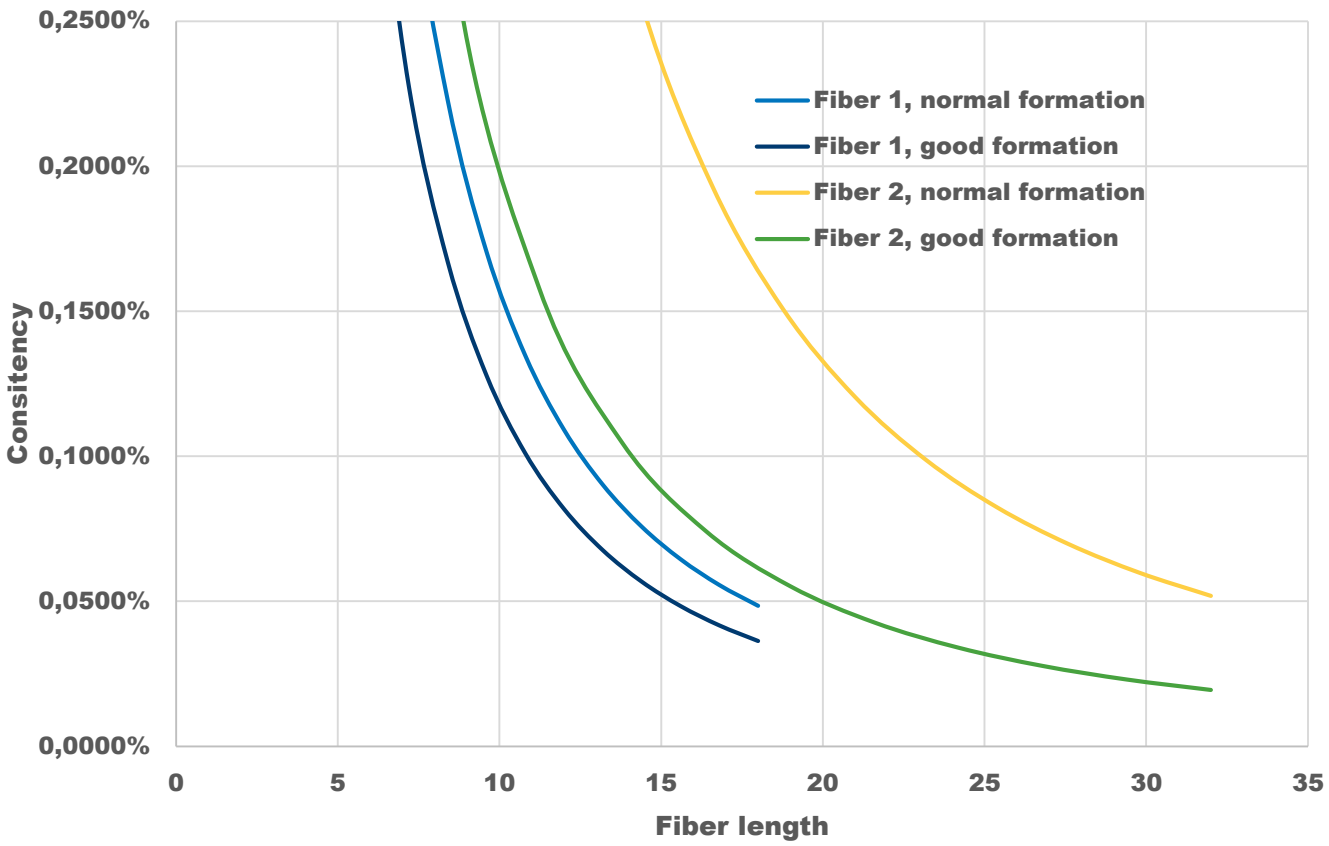
- **Viscosity modifiers: more resistance from the fluid and slow down agglomeration to flocs**
  **=> Consequence: More dispersing energy is needed**
- **Surfactants: Reduction of force by which the fibers agglomerate**
  **=> Consequence: To be minimized due to associated foam formation!**

**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

# GIVE THE FIBERS ROOM - CONSISTENCY

## The required flow defines the former design and fan pump choice

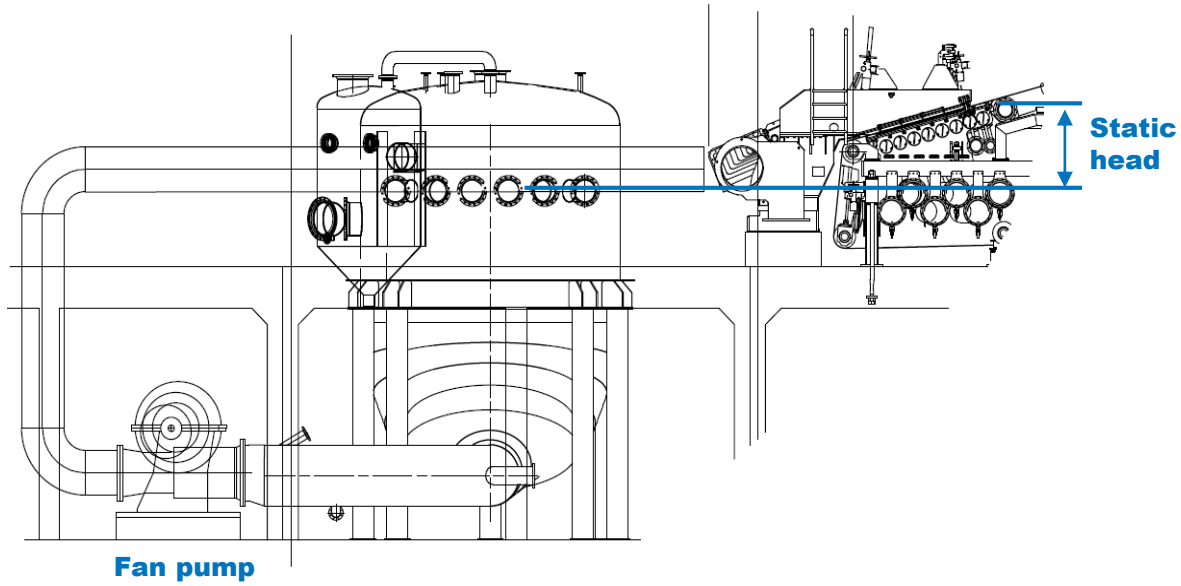



- **Consistency = weight-% of solids in the fiber slurry, AKA "solids"**
- **The longer the fiber, the lower the consistency need to be**
- **The lower the consistency, the higher the flow in the white water loop at a constant line throughput**
- **The capacity of the former and fan pump will be defined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

- **The former & the fan pump should be able to handle the large flow!**

# GIVE THE FIBERS ROOM - FAN PUMP

## Key figures for a centrifugal pump: Head



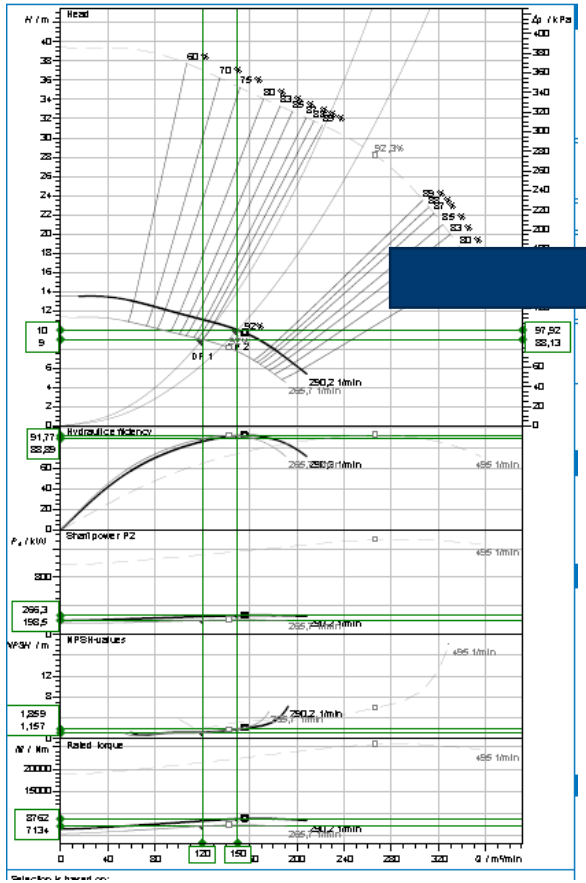

- **(Total) Head: The pressure difference between the discharge and suction side of the pump**
- **It consists of:**
  - **Static head (height difference between level on suction side and discharge side)**
  - **Vacuum in the white water return tank**
  - **Friction head (friction losses, caused by the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

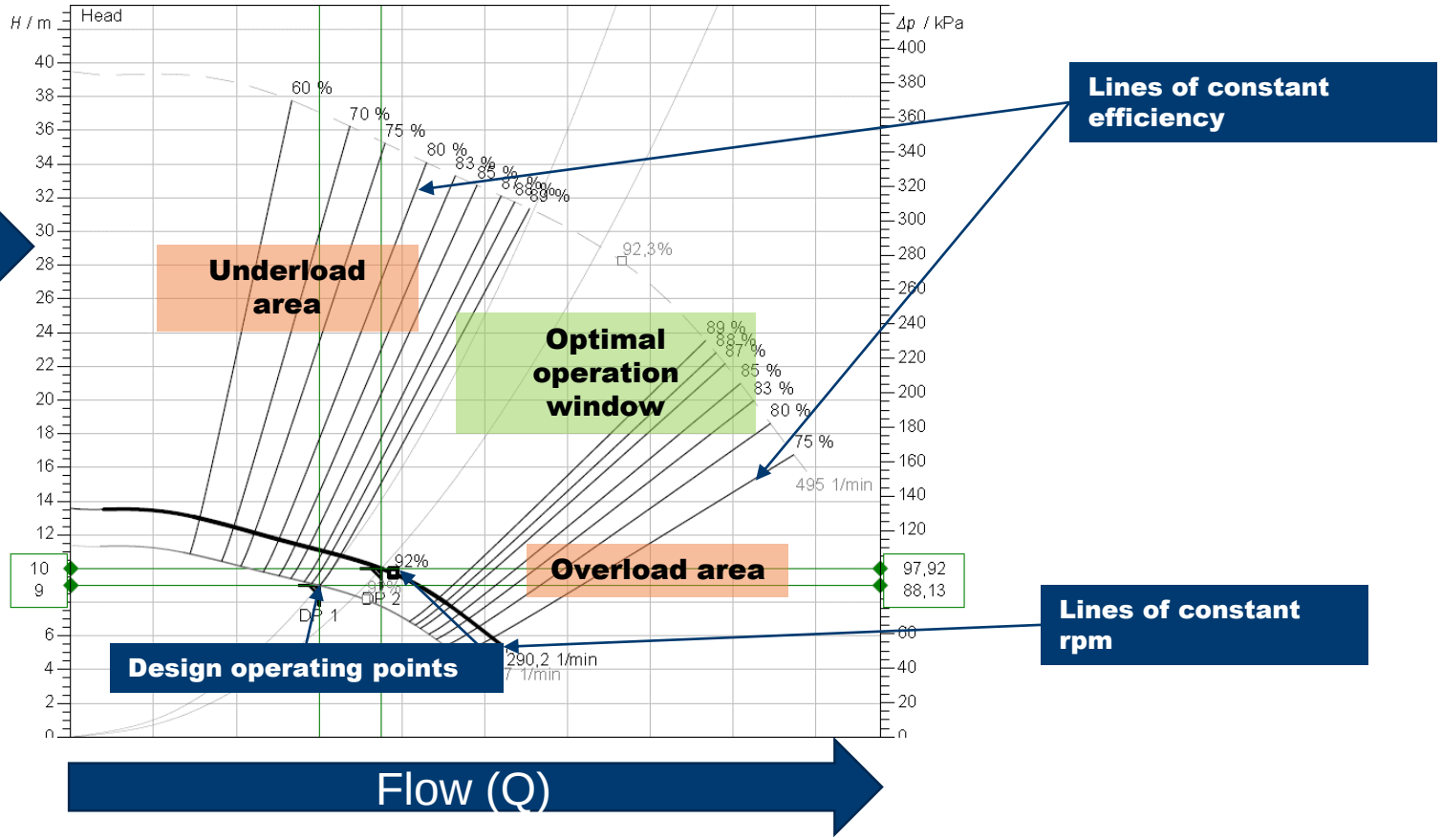
**Friction head is based on assumptions because of the operating range diversity of a line, chemicals usage and associated complex calculations.**

**The range of real total head value of an inclined wire former requires design slack**

# GIVE THE FIBERS ROOM - PUMP CURVES

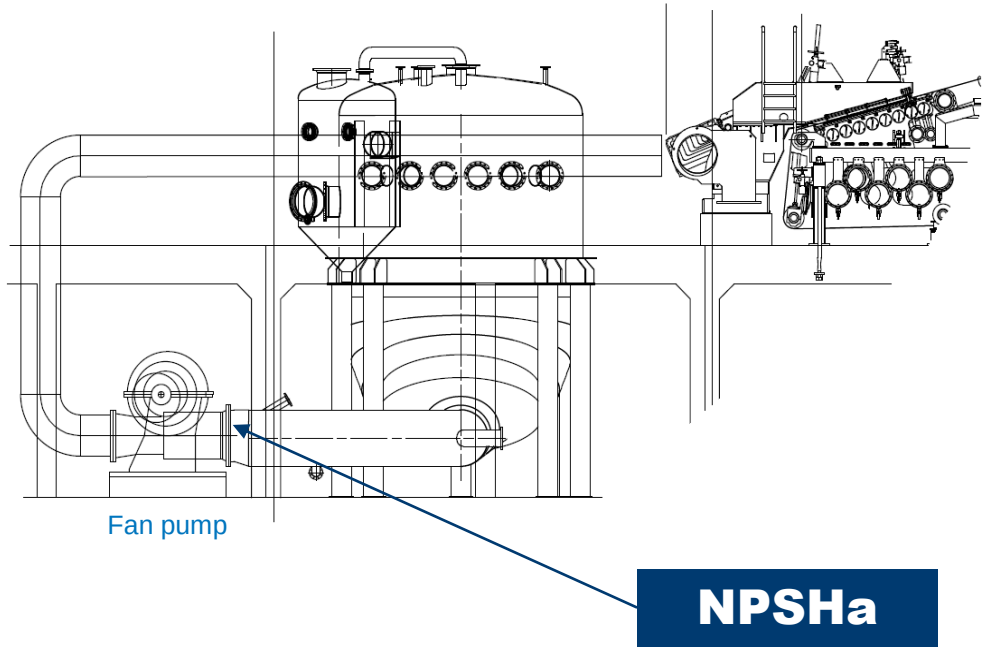
## The Q-H curve (Q=Flow; H=Head)





# GIVE THE FIBERS ROOM - FAN PUMP

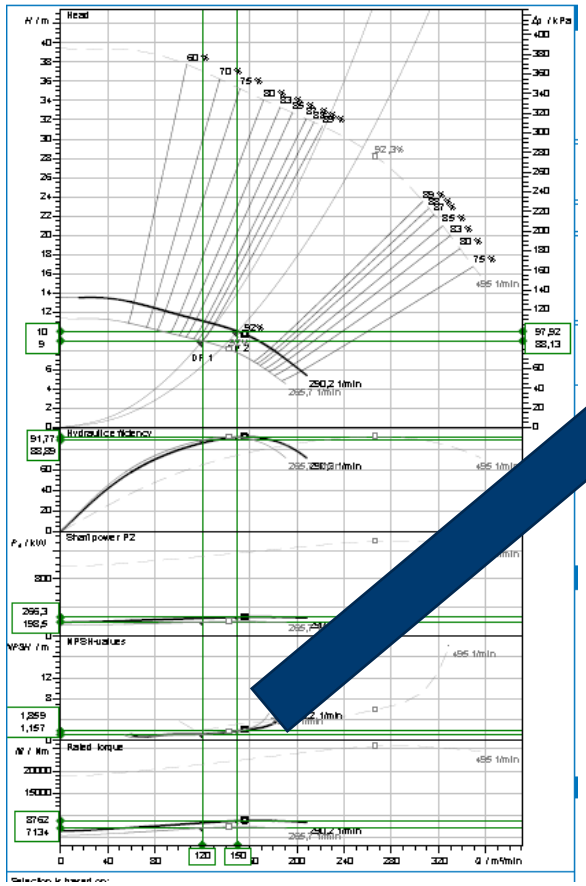
## Key figures for a centrifugal pump: NPSH

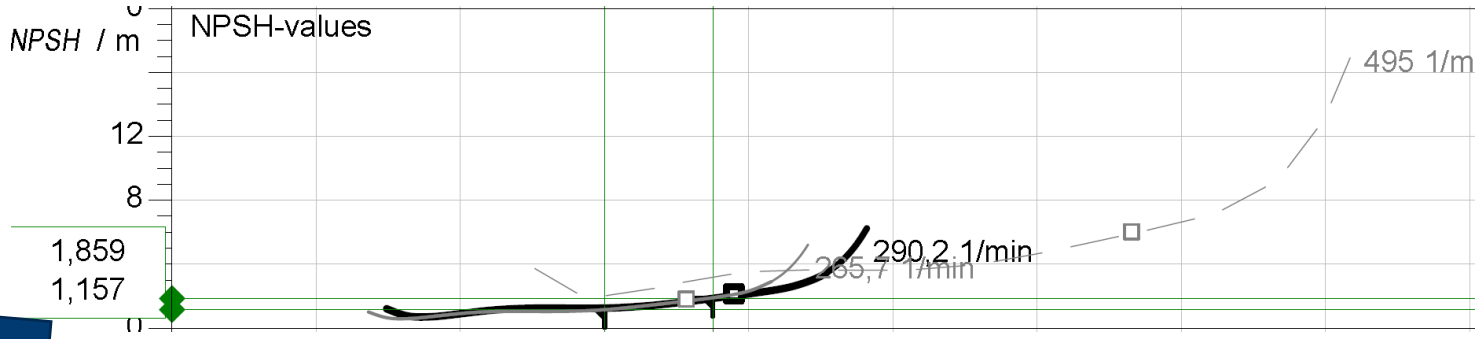



- **NPSHa: Net Positive Suction Head available (at the suction flange of the pump) is the Absolute Pressure head minus the Vapor Pressure of the liquid.**
- **NPSAa is the result of a process design. An important influencers is the level above the suction flange.**
- **NPSHr: NPSA required and is directly 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.**

# GIVE THE FIBERS ROOM - PUMP CURVES

## The NPSHr curve

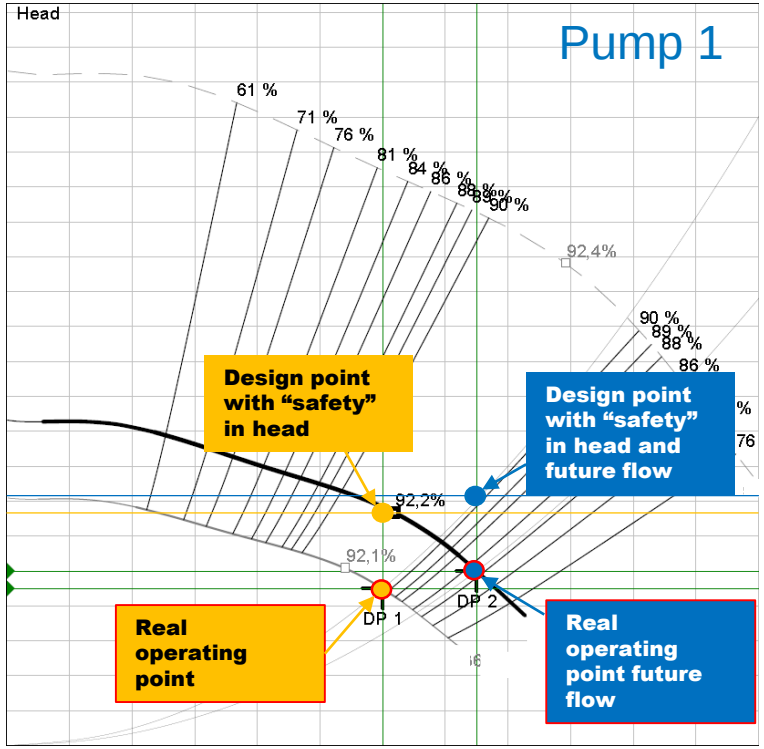


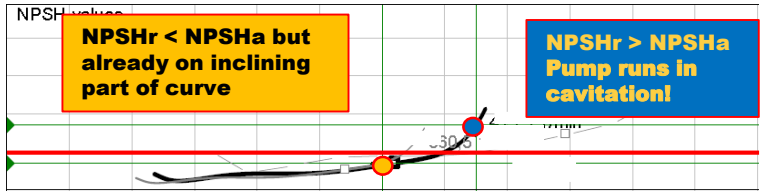


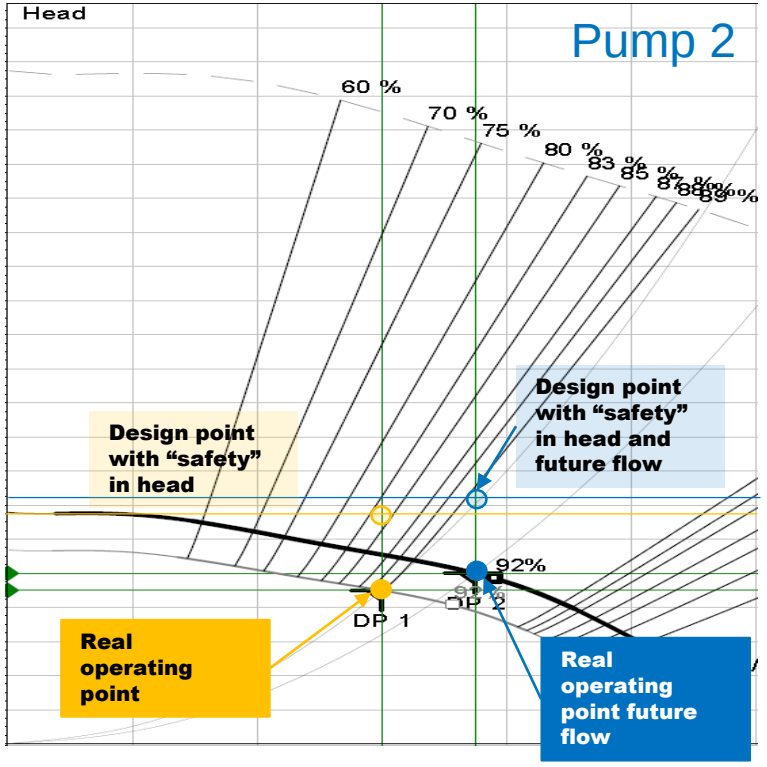

- **The NPSHr curves are giving the NPSHr for each constant RPM line**
- **Optimal operating points for NPSHr are in the most horizontal part of the curve**

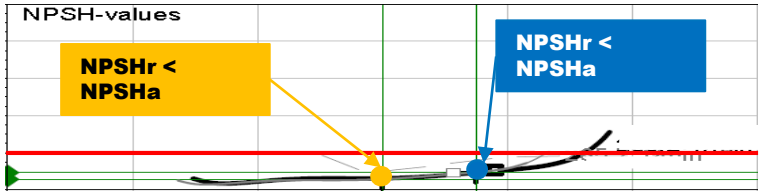
# GIVE THE FIBERS ROOM - COMPARE 2 PUMPS

## 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 significant 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**

# GIVE THE FIBERS ROOM - FAN PUMP

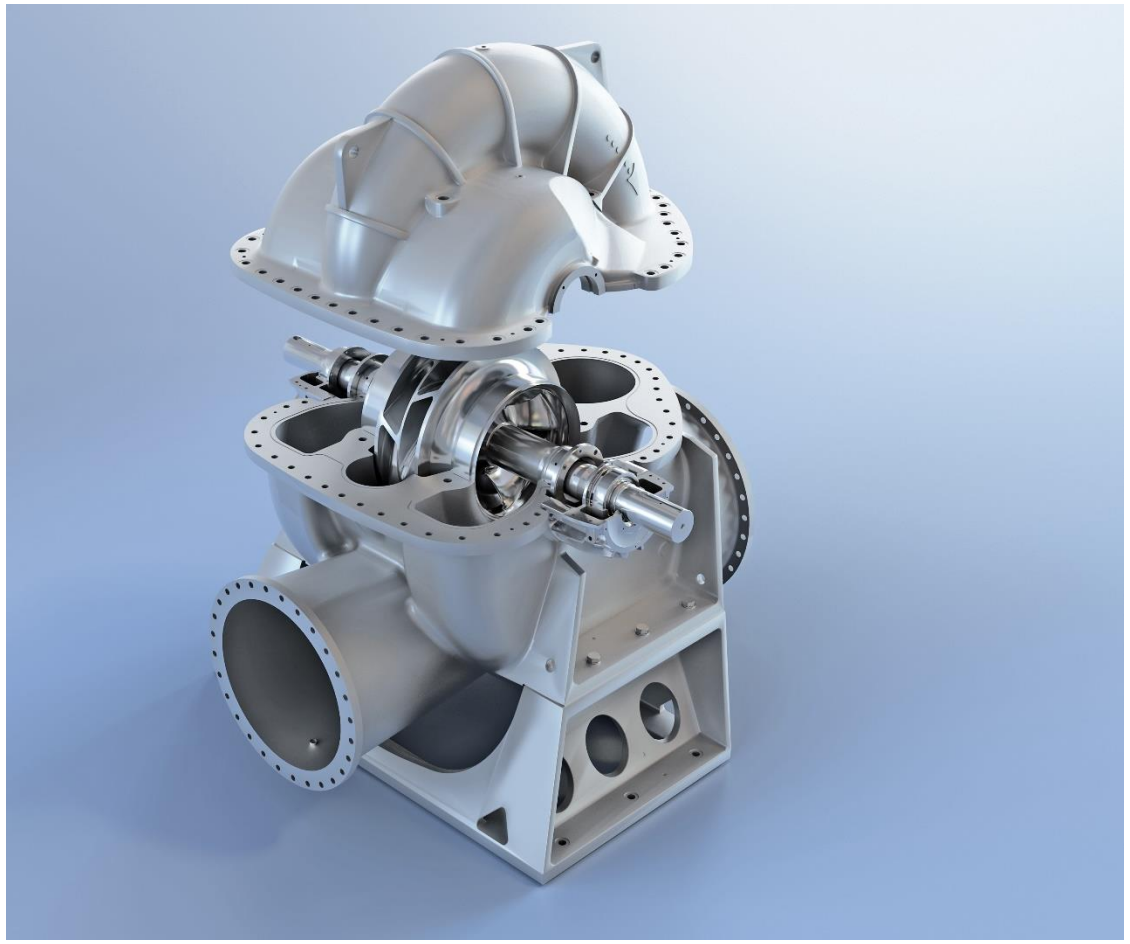
## Low pulse - double suction – split case pumps

**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 NPSHa > NPSHr?**

**Too small pumps and shallow basement are suspicious!**



# CHAPTER OVERVIEW

# DISPERSING – KEEP THE FIBERS MOVING

## Mixing fibers in white water: Flocs but no clumps…



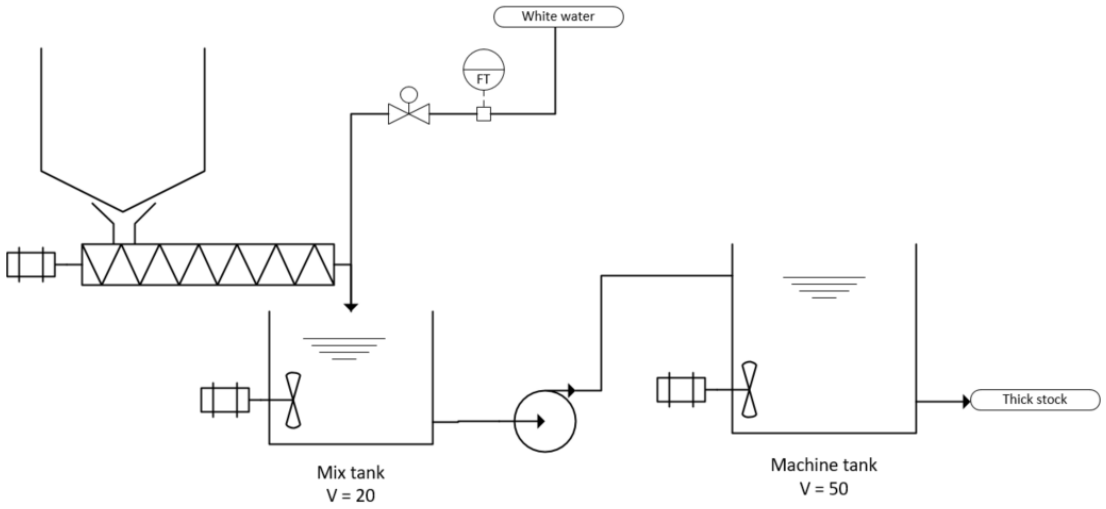

**Mixing glass fibers in white water is:**

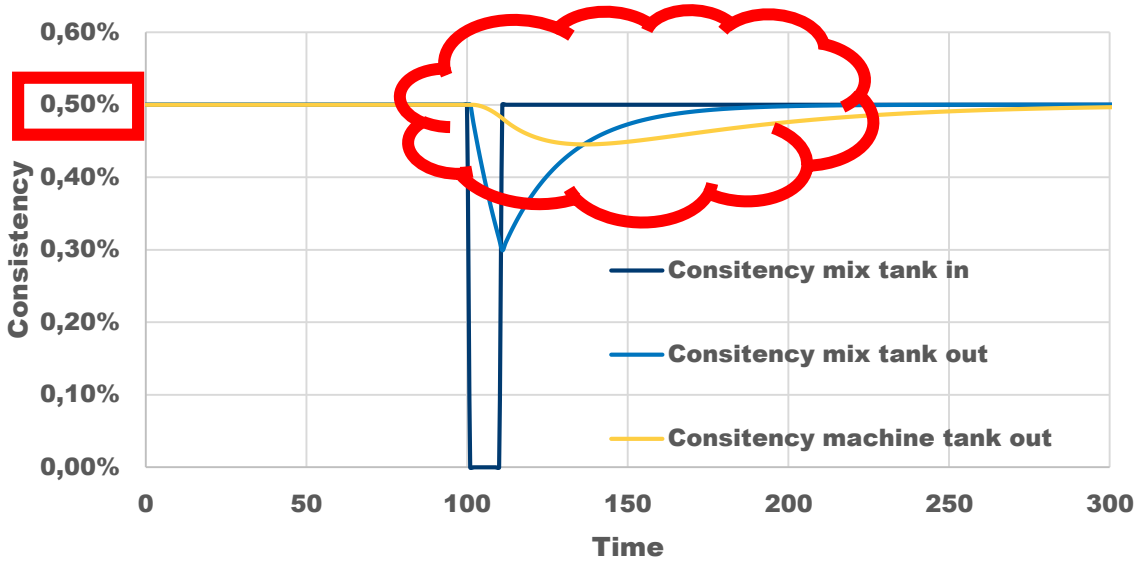
- **Depending of the fiber length and diameter**
- **Depending of the fiber finish**
- **Depending of the white water chemicals**
- **Depending of the residence time in the mix and store chests**

**Testing of glass fiber dispersing in specialized technology centers is highly recommended before choosing the type of mixers and stock prep configuration!**

# DISPERSING – KEEP THE FIBERS MOVING

## Dilution water in steps

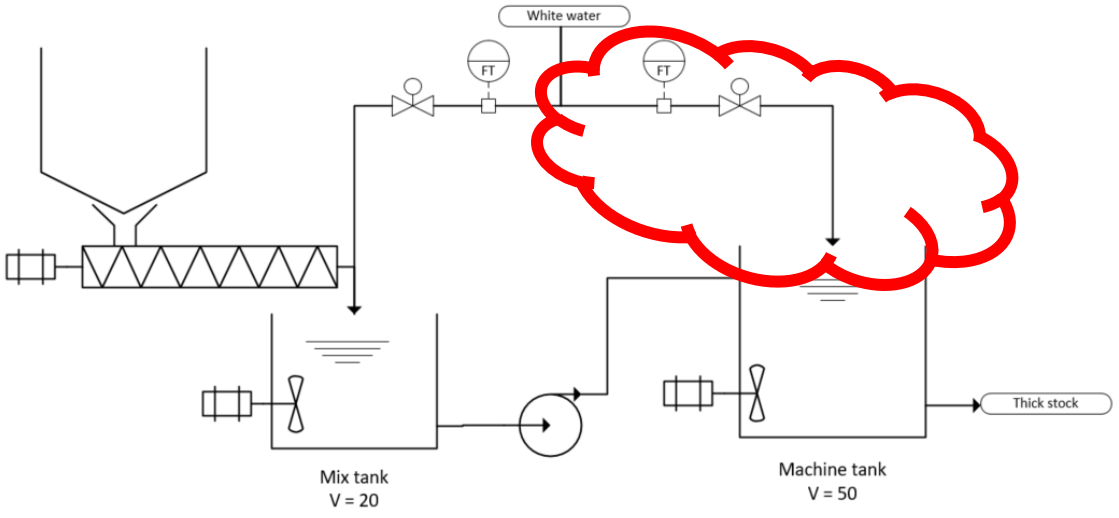


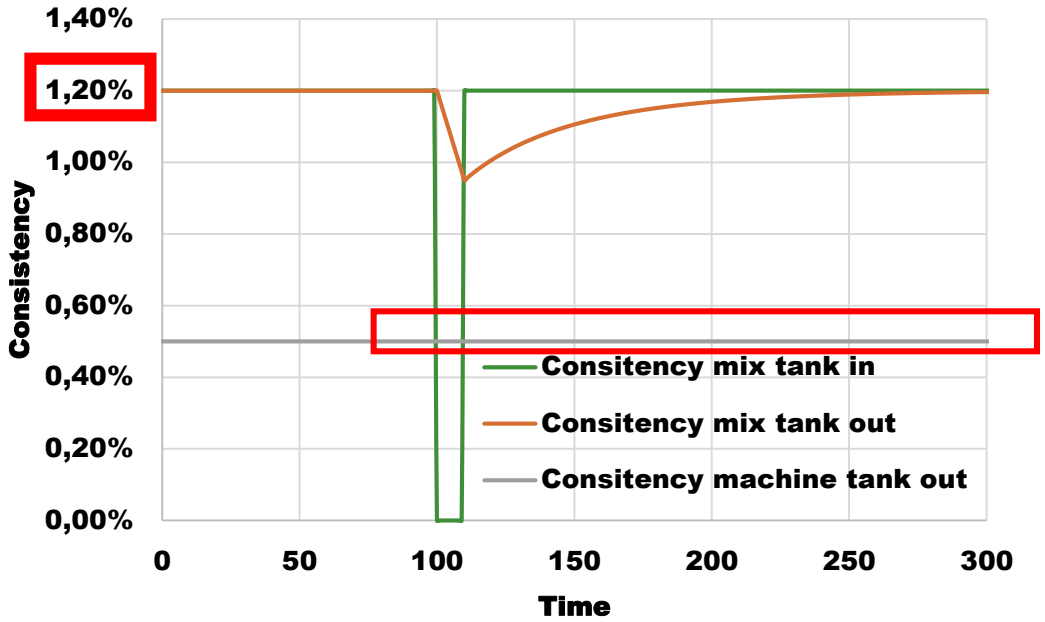




- **For most glass fibers, dosing fibers in one step to the final thick stock consistency is not the optimal solution**
- **Beside suboptimal dispersing, there is no possibility to adjust fiber dosing fluctuations/errors**

# DISPERSING – KEEP THE FIBERS MOVING

## Controlled second dilution step

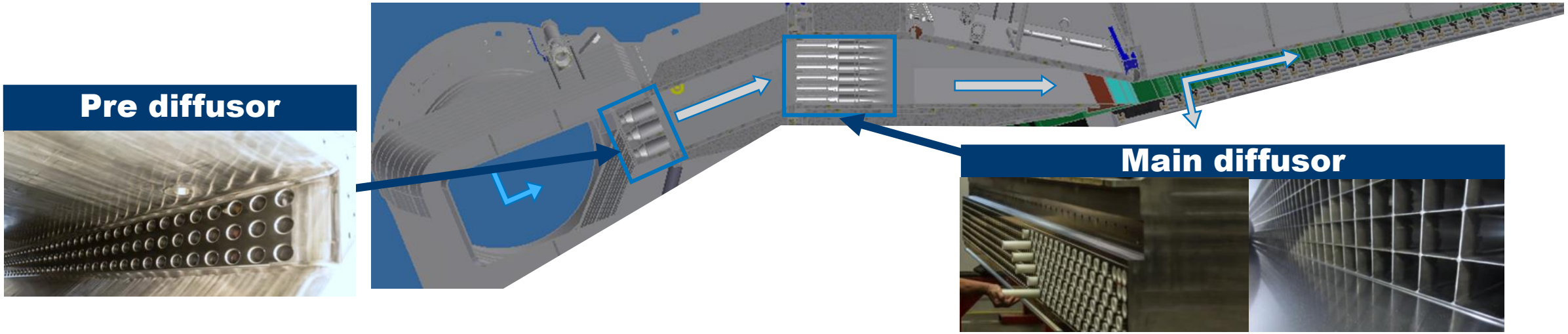



- **Mixing on higher consistency. This is very often more efficient.**
- **Extra dilution step can reduce consequences of fiber feed dosing errors.**

# DISPERSING – KEEP THE FIBERS MOVING

## Double diffusor

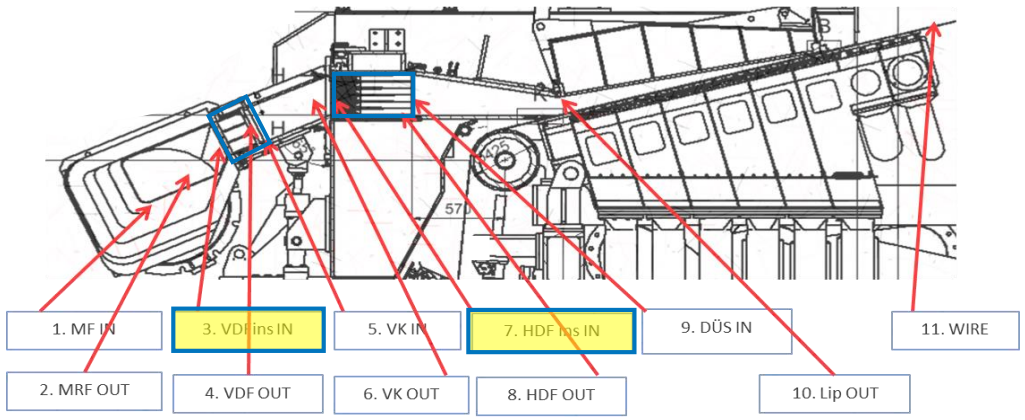


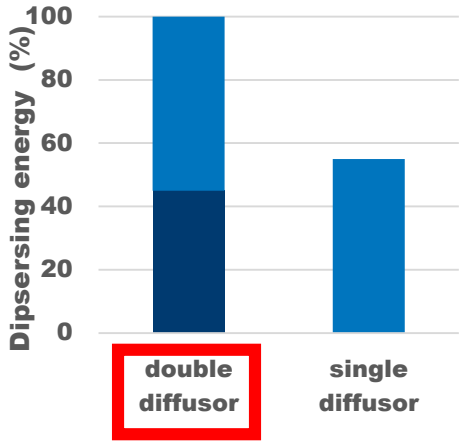

**Decoupling of functions**

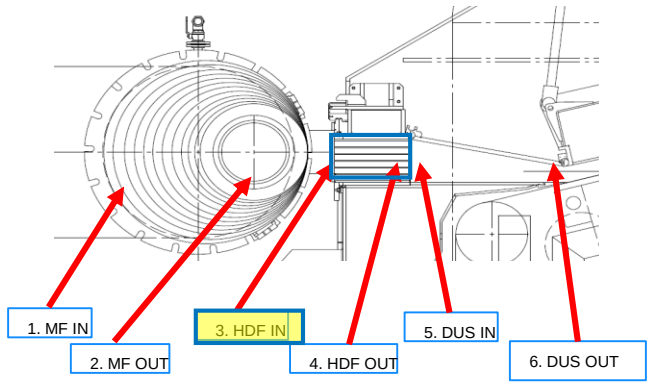
- **Pre diffusor** for changing flow in header from cross machine direction in machine direction
- **Main diffusor** optimized for optimal turbulence: Defloccing

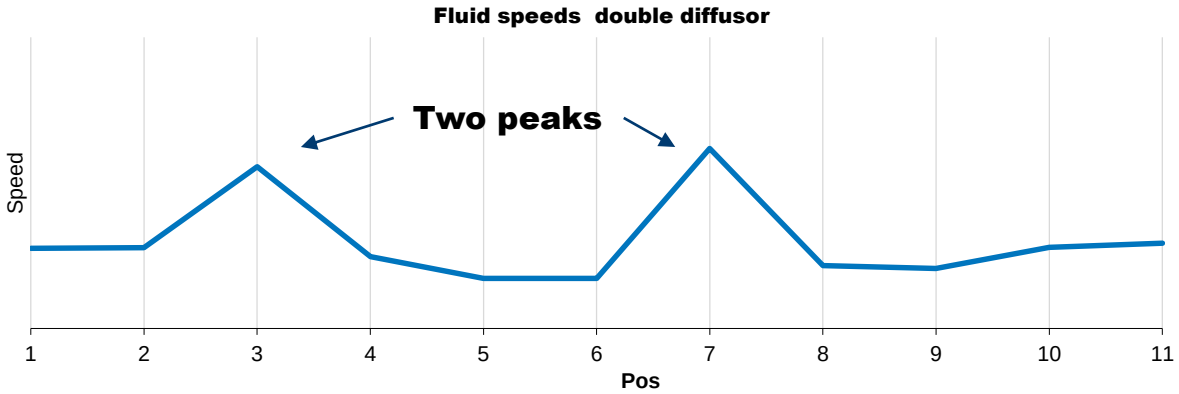
# DISPERSING – KEEP THE FIBERS MOVING

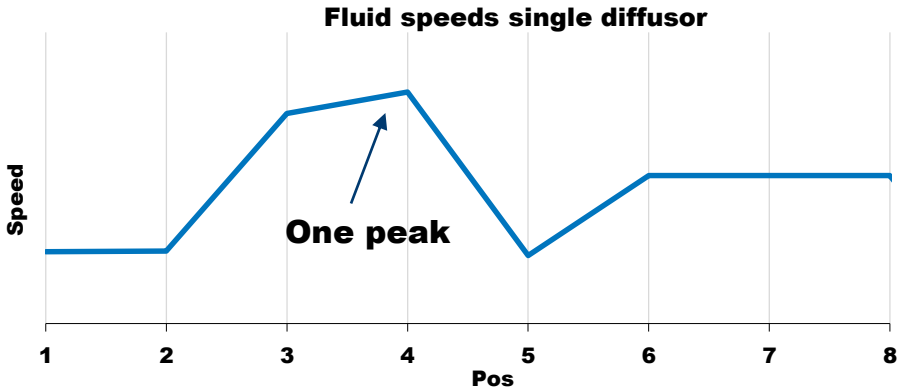
## Double diffusor => More <u>DISPERSING ENERGY</u>



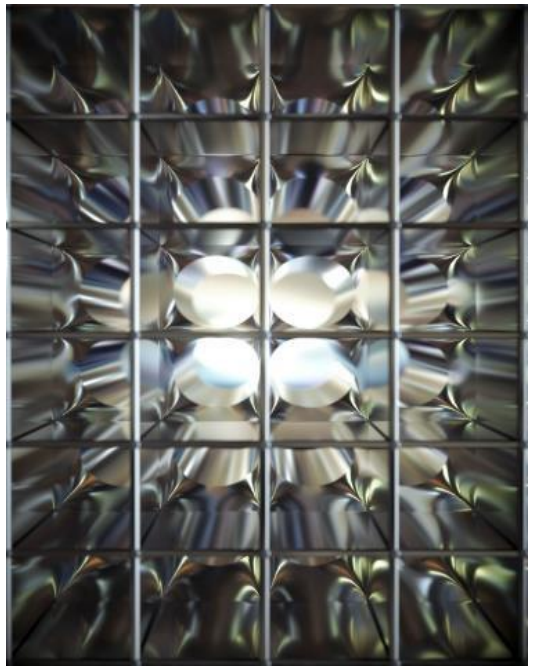



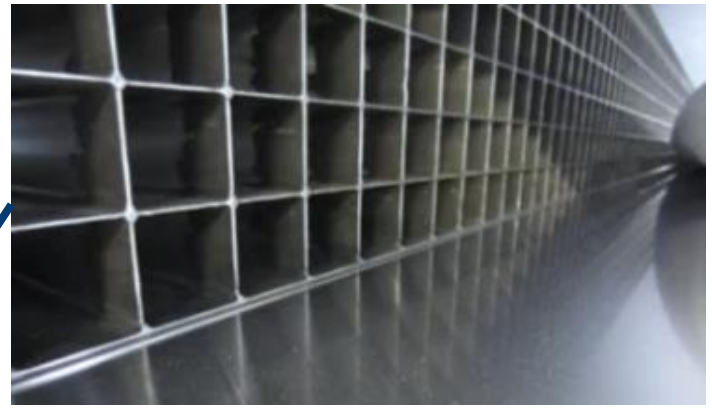



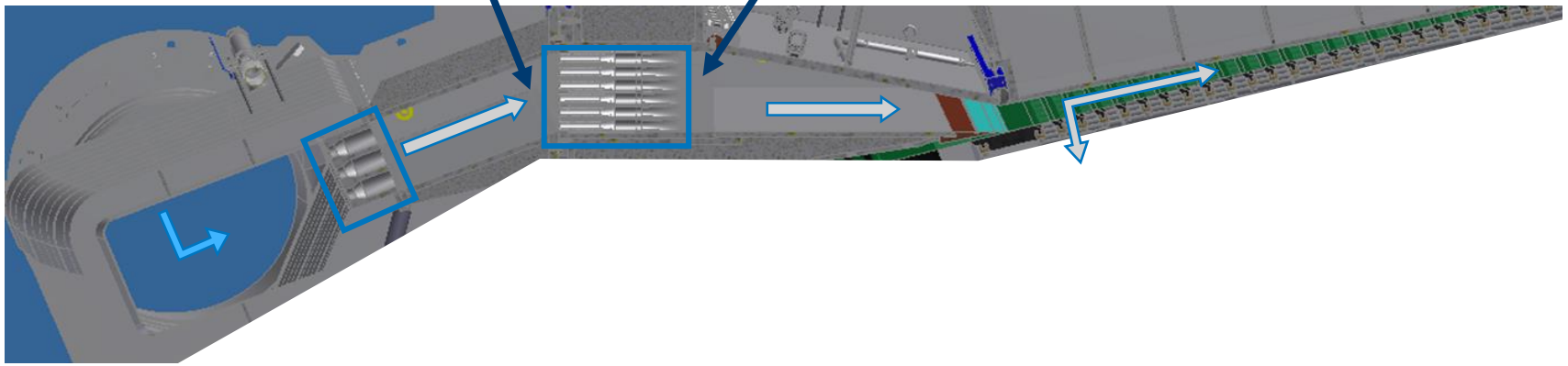
# CHAPTER OVERVIEW

# FORMING THE WEB – GOOD FIBER LAYING

## Guiding of the slurry flow to the wire

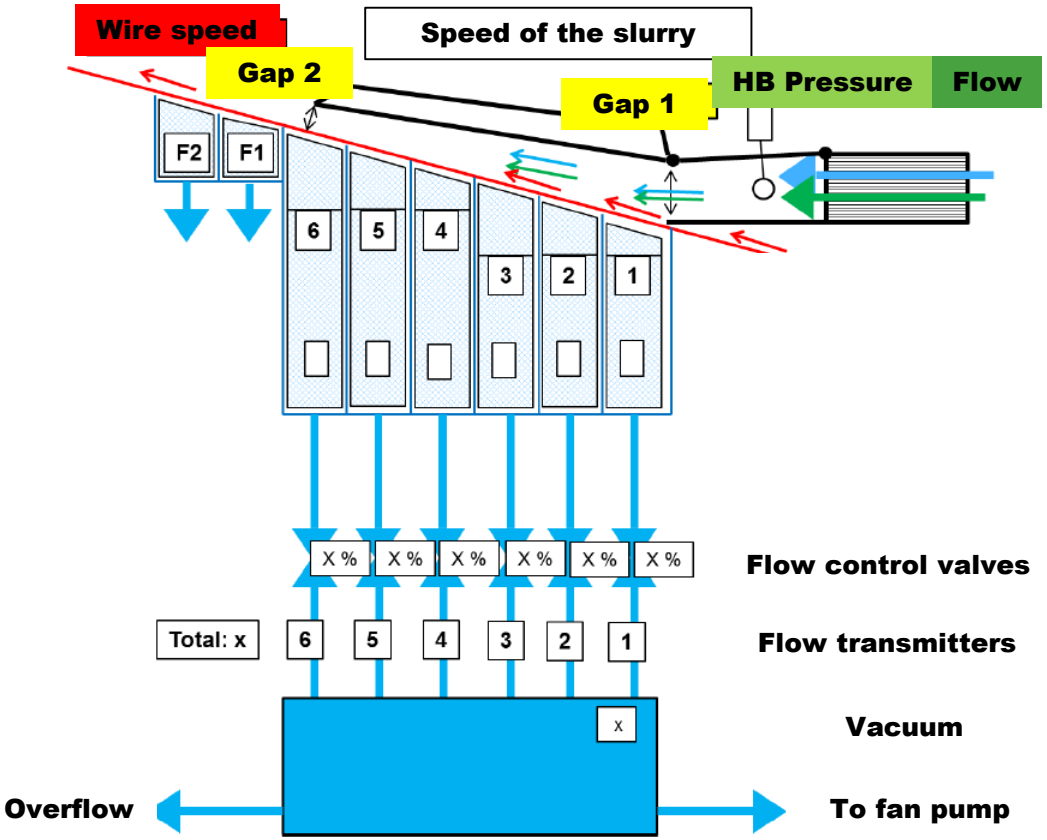


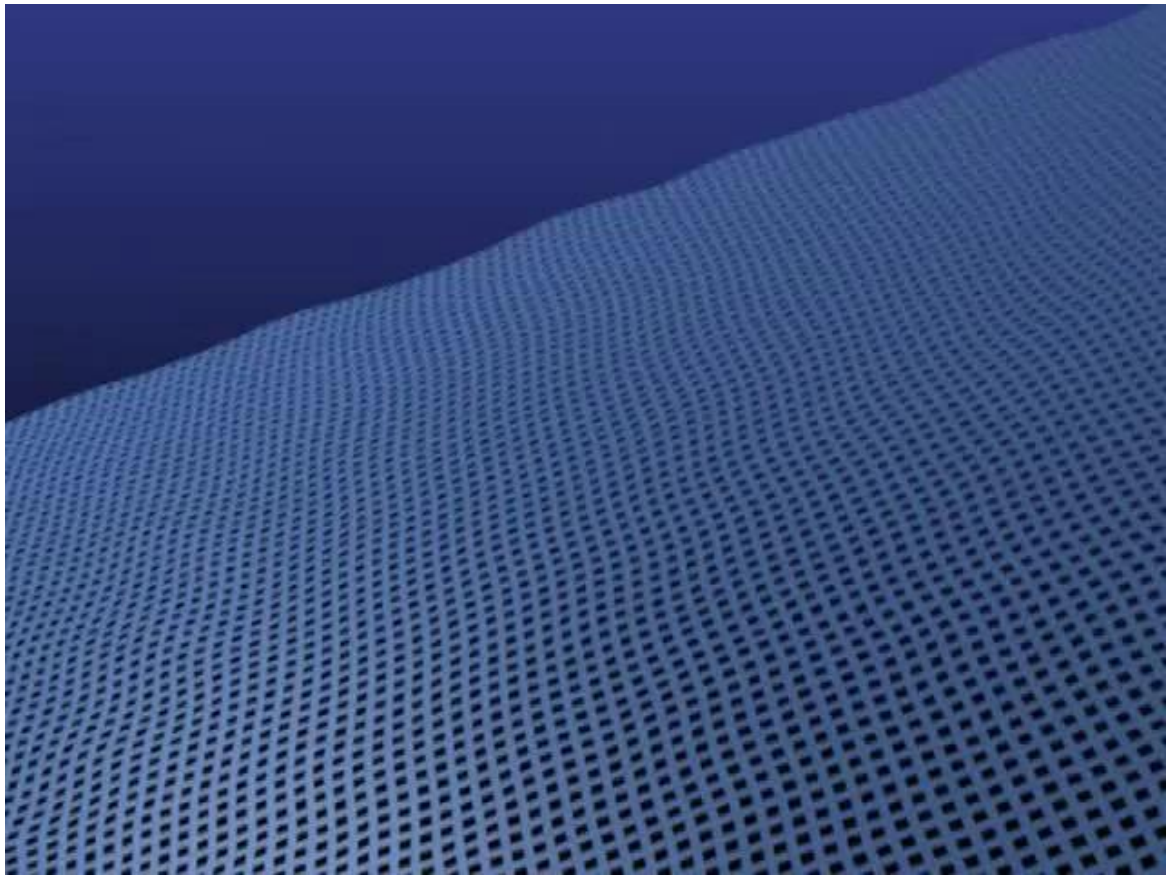




# FORMING THE WEB – GOOD FIBER LAYING

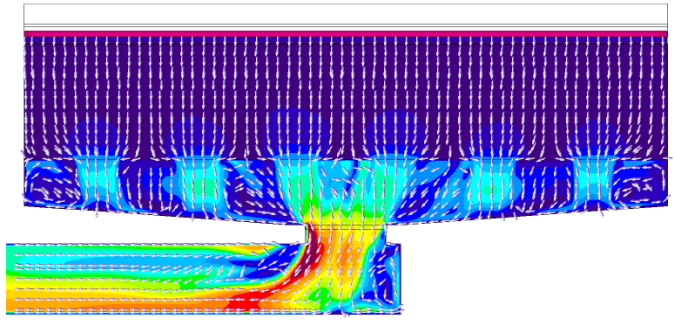
## Control factors for forming process

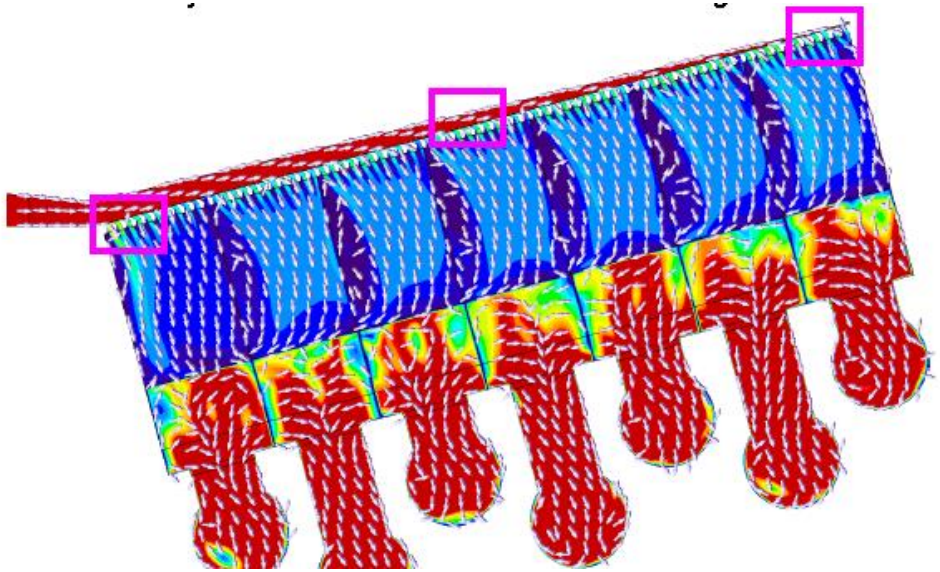


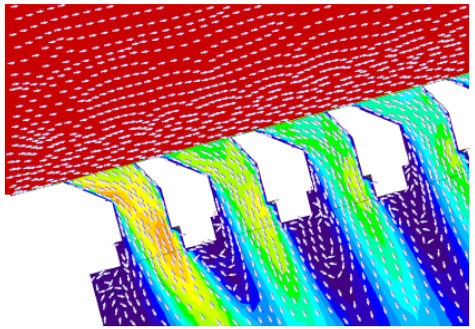



# FORMING THE WEB– GOOD FIBER LAYING

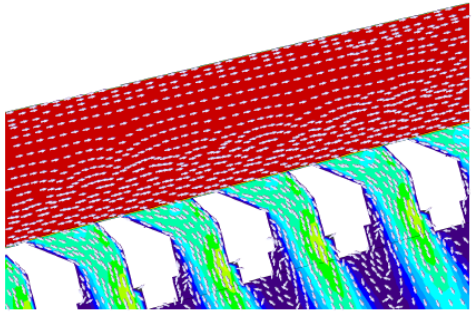
## Even dewatering in Machine Direction and Cross Machine Direction



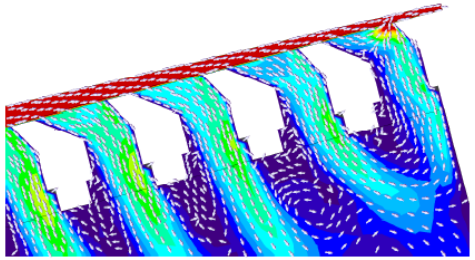




Near Former Inlet



Near Former Middle



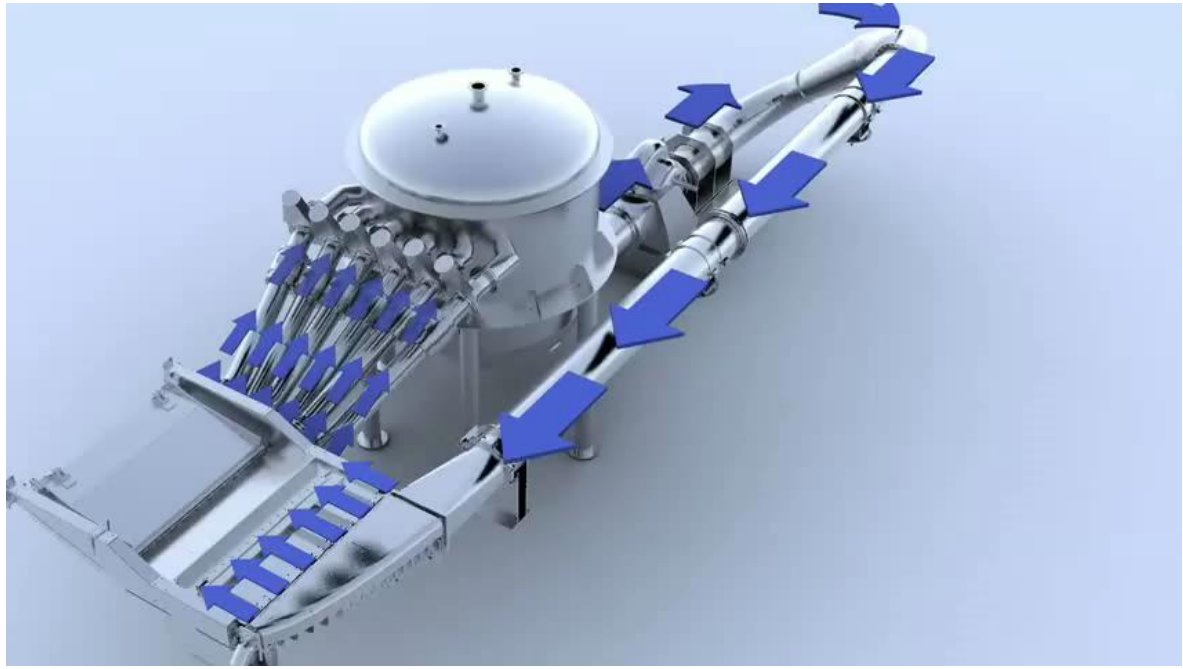
Near Former Outlet

# 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

# WE LOOK FORWARD

Our team is at your disposal

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