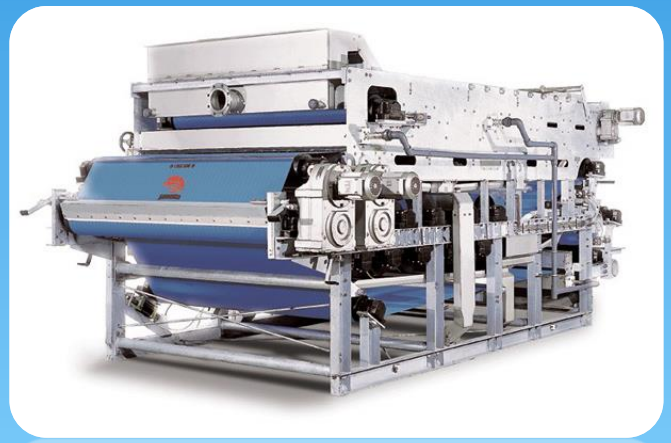
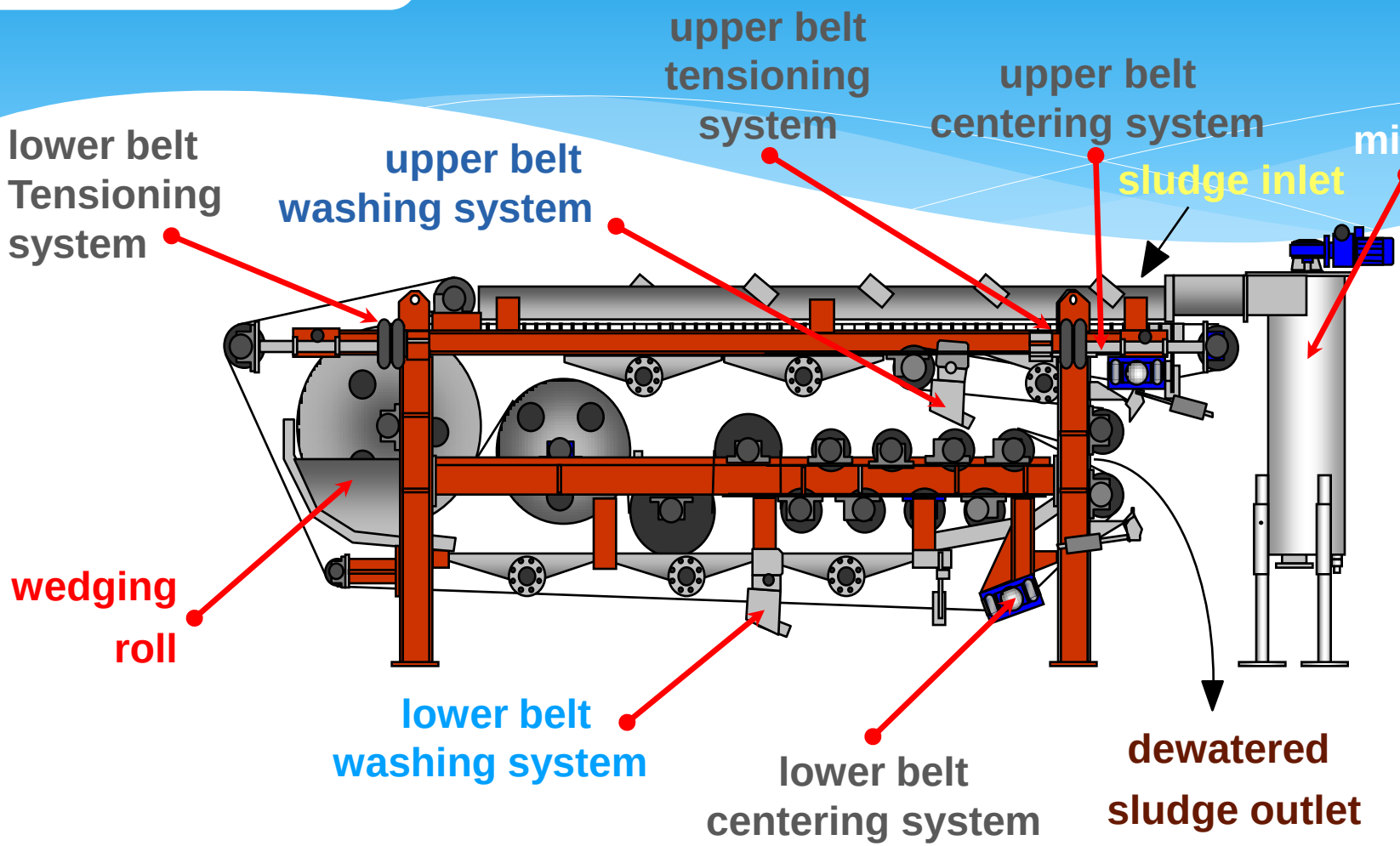
Langley Separation & Process
Belt Press 101
Operational Training



Applying 40-Years of Experience and Process Knowledge

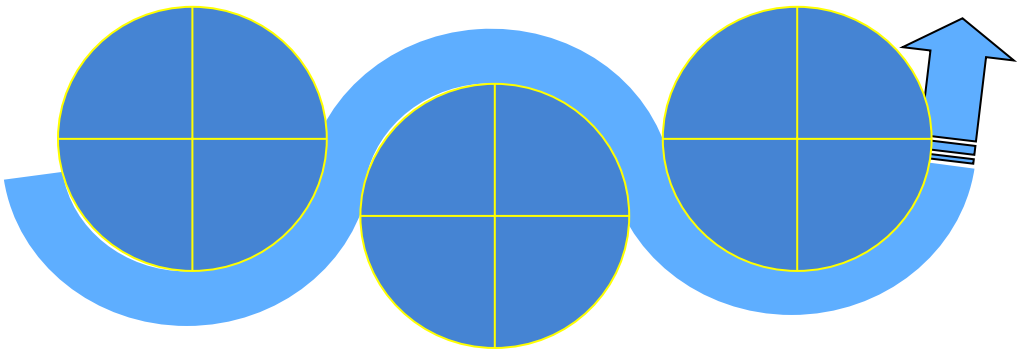
LANGLEY
separation and process

Belt Press Side View



Dewatering Fundamentals

- **Process**
- **Mechanics**

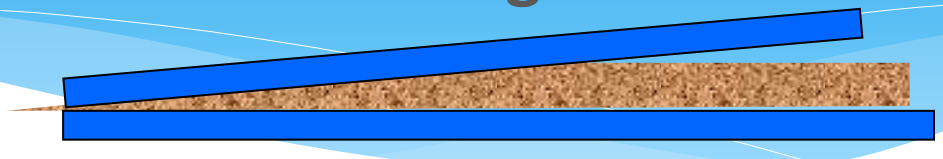


Process Components

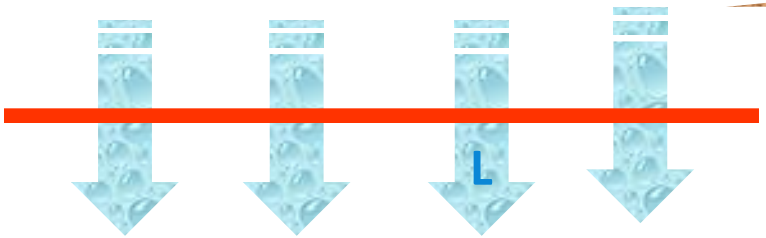
- Flocculation / Conditioning
- Gravity zone
- Low pressure
- High pressure

Filtration Zones

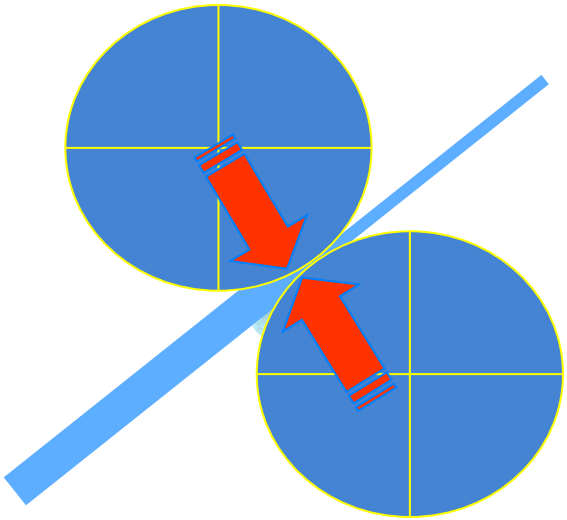
Wedge



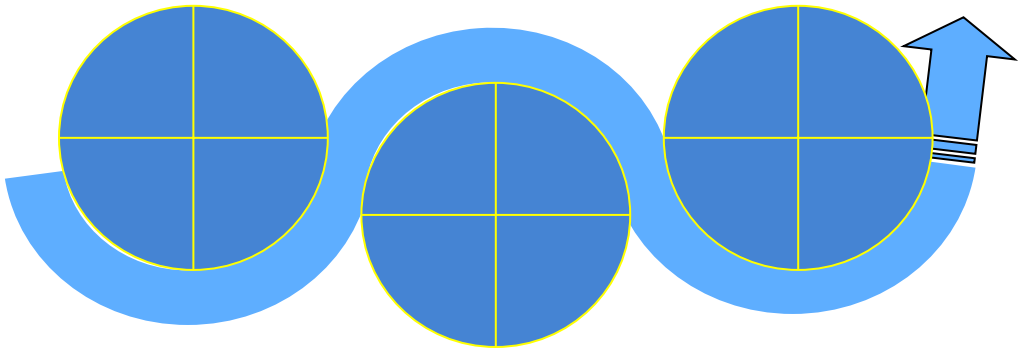
Gravity



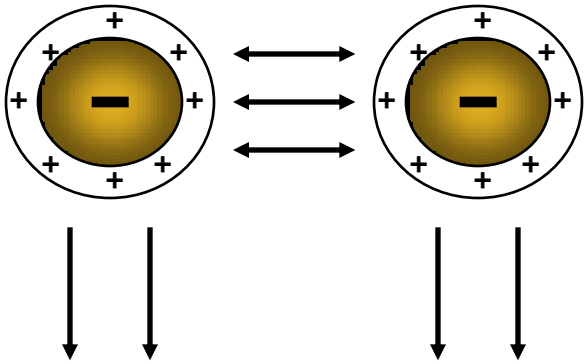
Linear Pressure



High Pressure

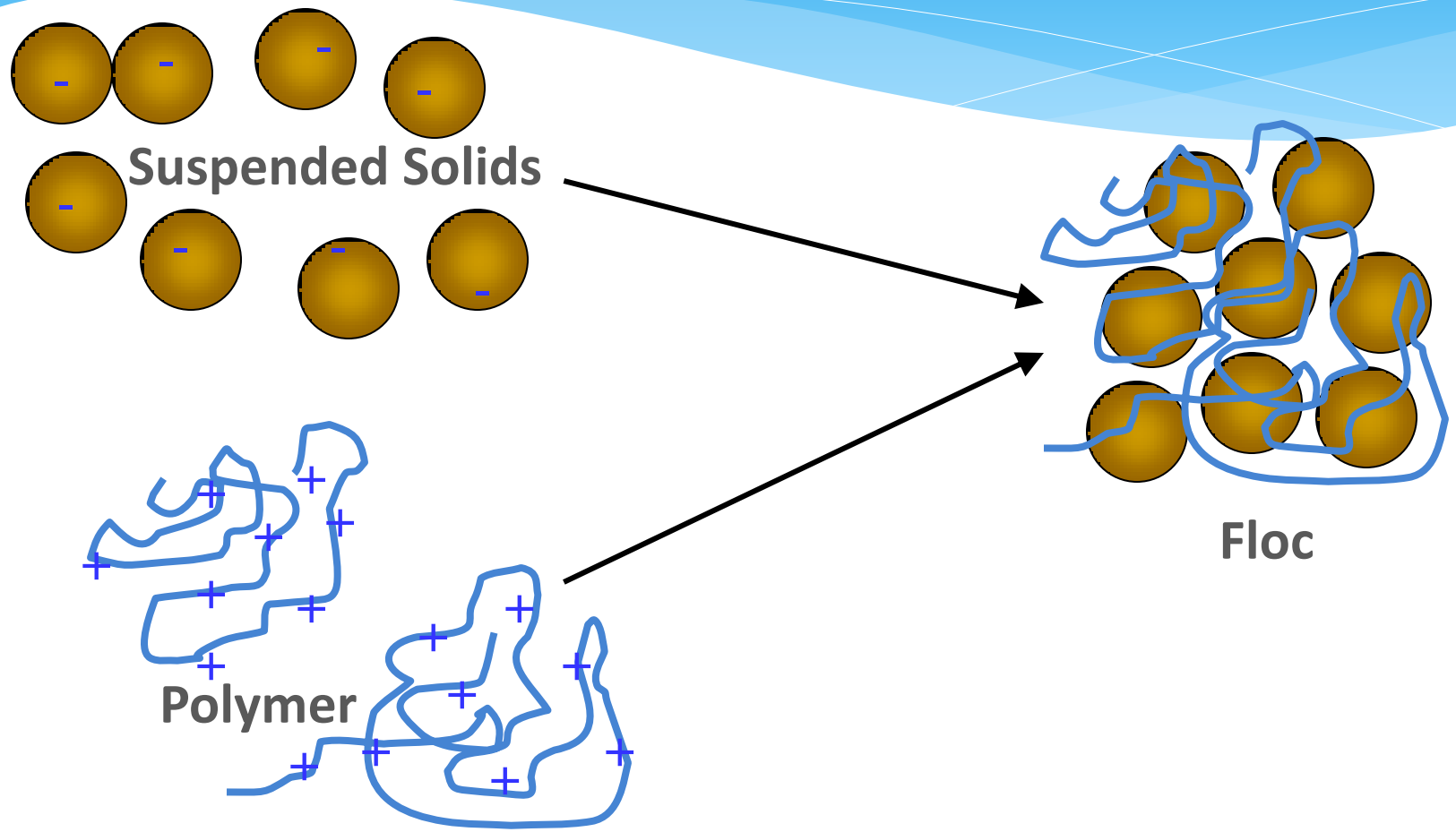


Colloidal Particles



- Most of the particles we must remove have a negative charge.
- Shells of cationic charges form around the particles.
- The force of repulsion between the particles is stronger than the force of gravity.
- As a result the particles stay in suspension.

Flocculation

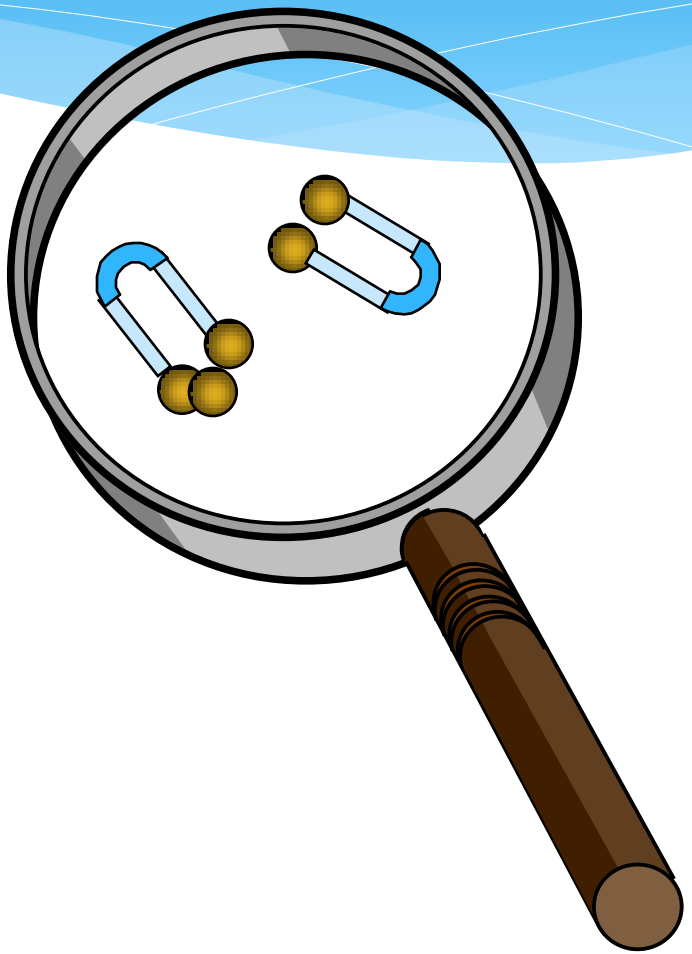


How Polymers Work

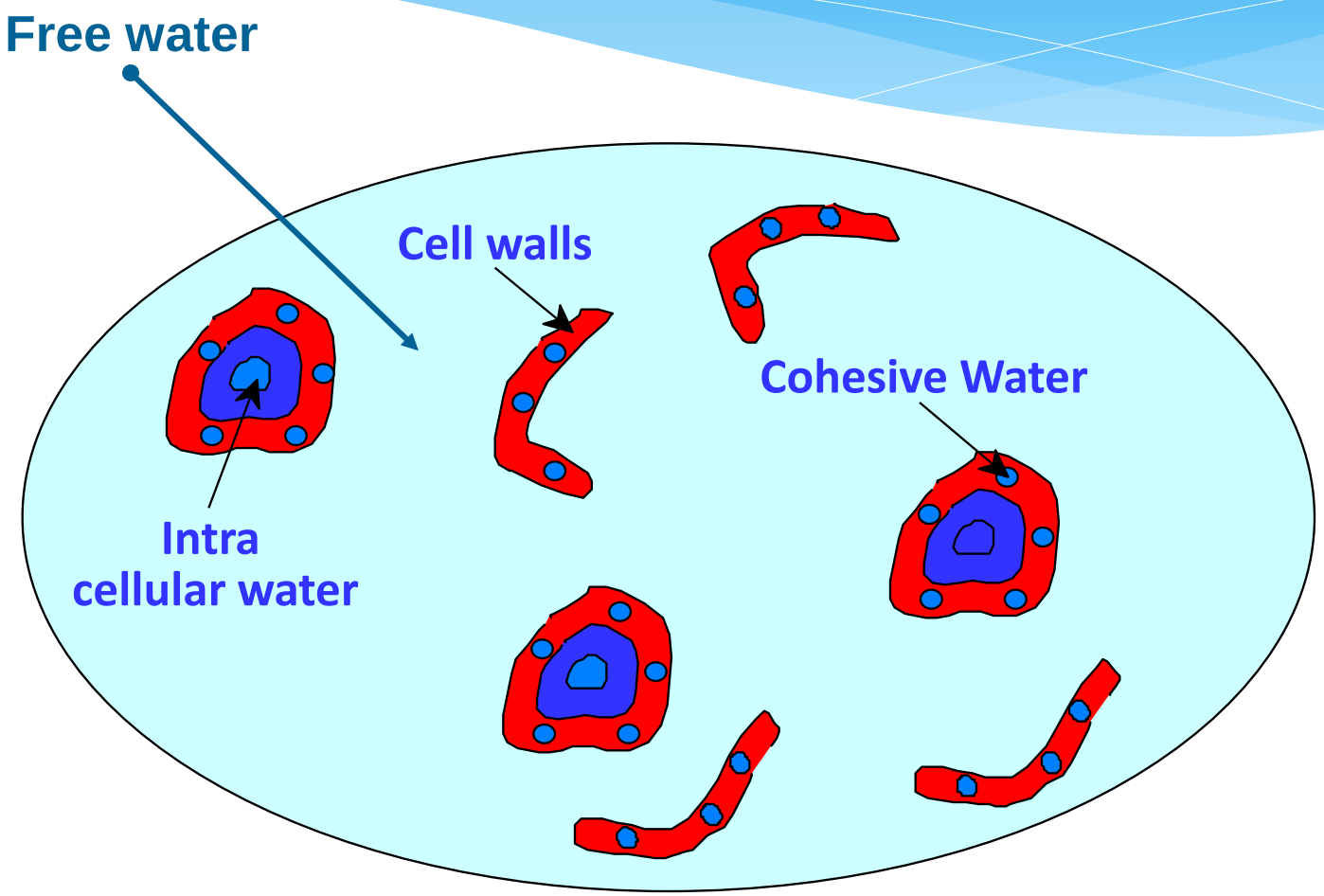
The primary mechanism is electrostatic attraction

Attractions between positive and negative charges

Analogous to magnetic attraction



Types of Water in a Biological Suspension



Conditioning Systems

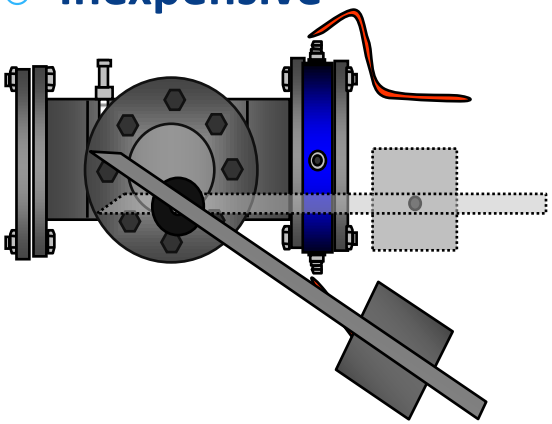
- **Venturi Effect**
- **Mechanical**
- **Combined**

Conditioning

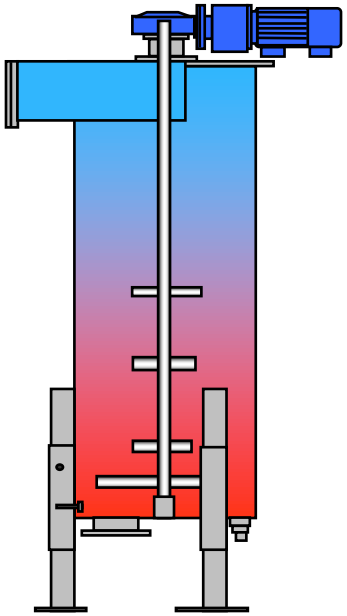
- **Polymer injection**
- **Mixing**
  - **Static**
  - **Mechanical**
- **Detention time**

Mixing Devices

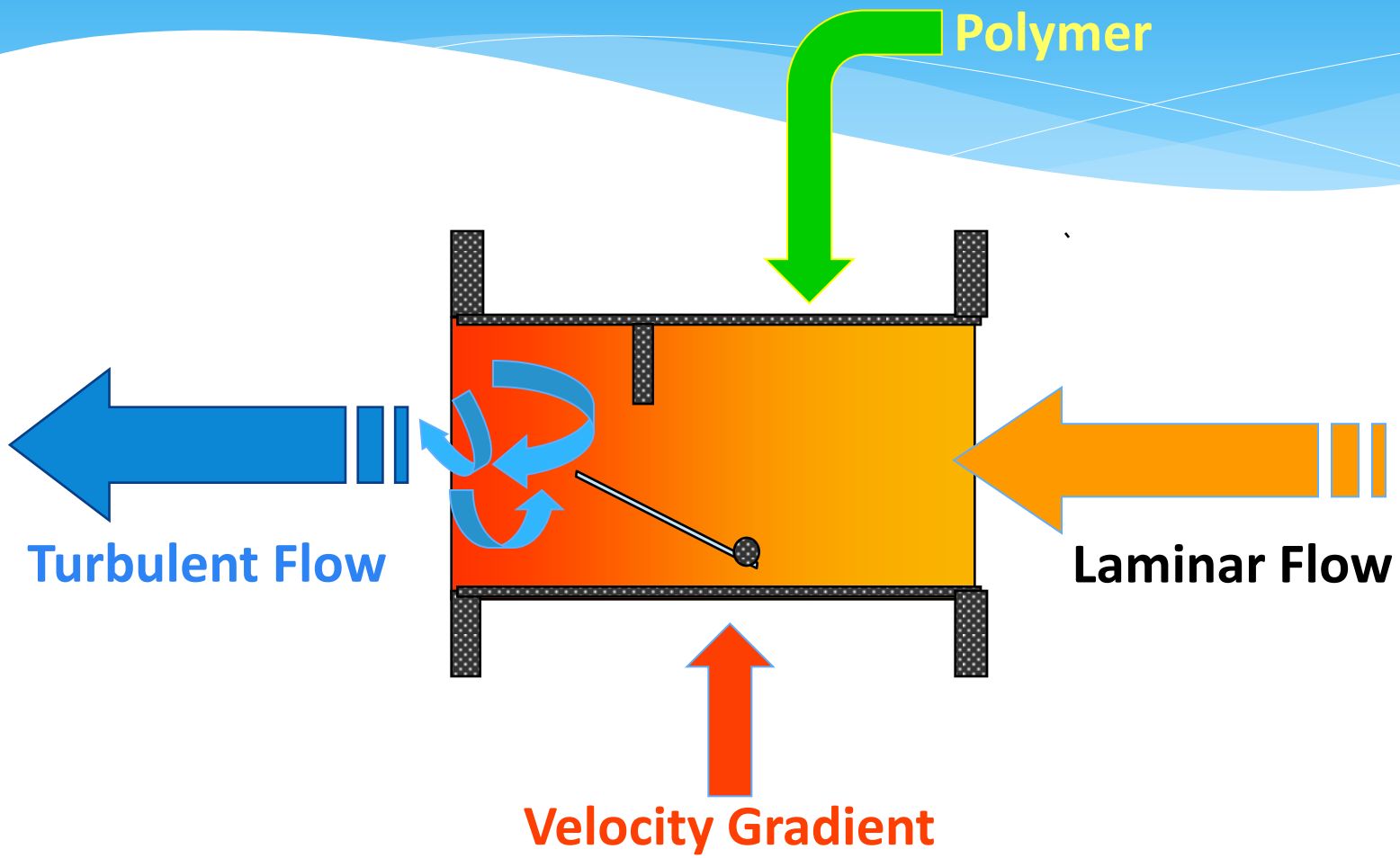
- **Static**
  - Zero detention time
  - Sensitive to changes in velocity and viscosity
  - Increase head loss
  - Reduced effectiveness >2%
  - Inexpensive



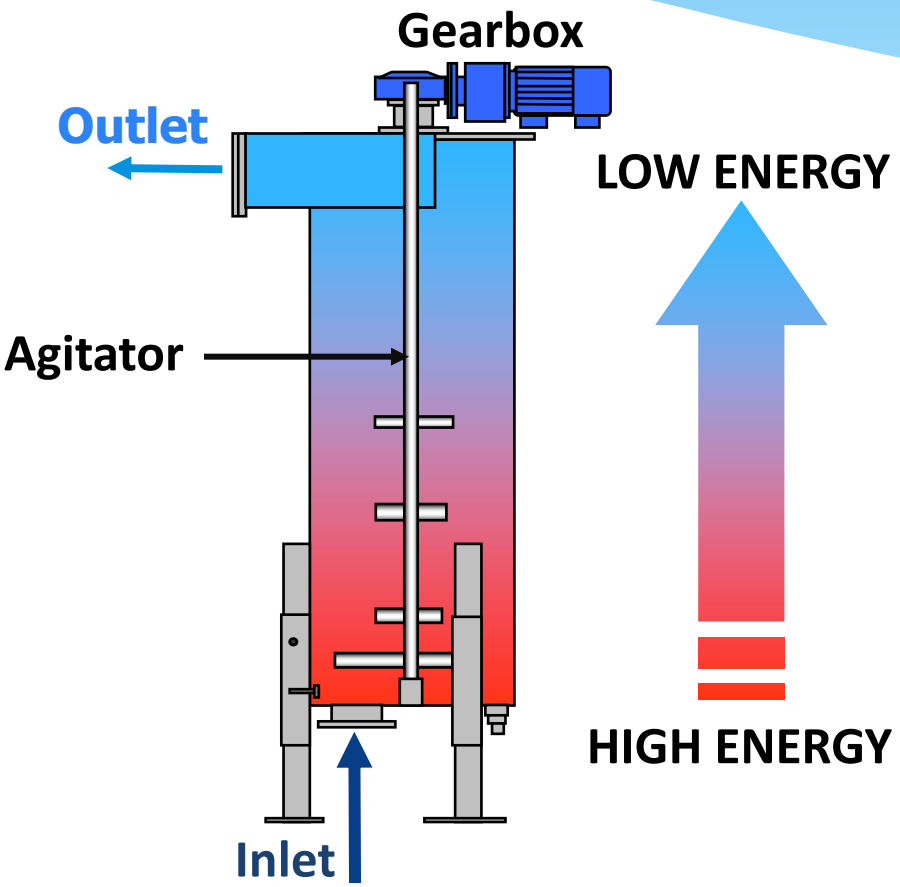
- **Mechanical**



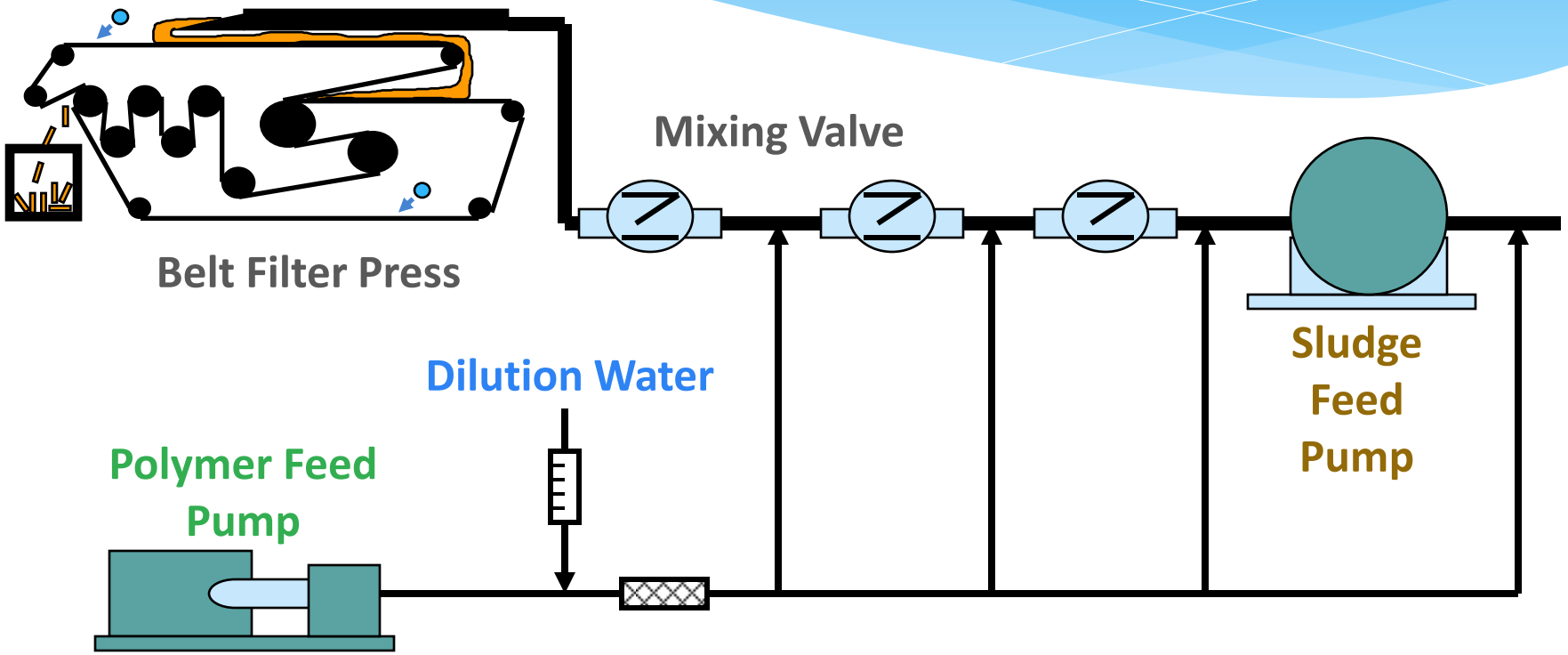
Venturi Effect



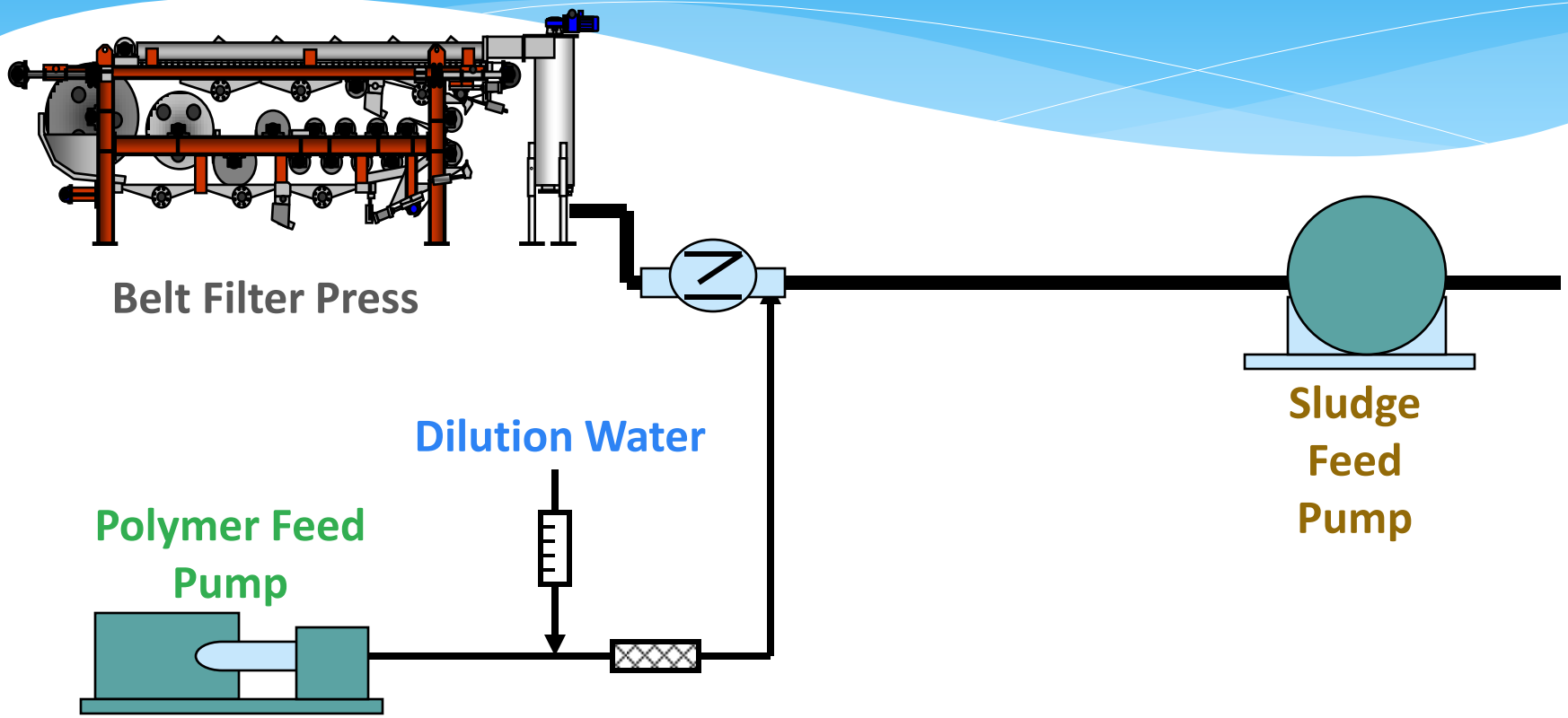
BPF WR Sludge Mixer



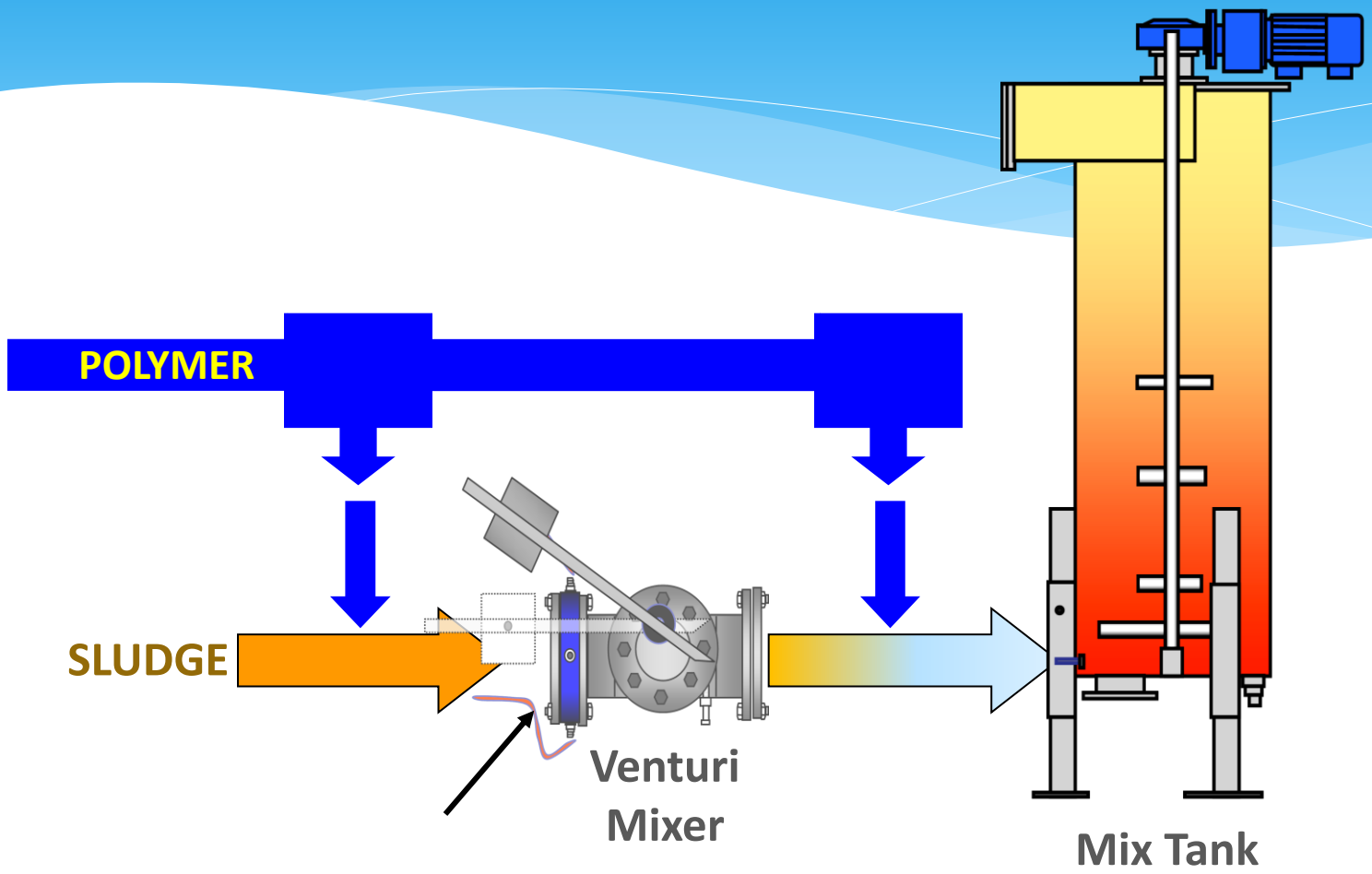
Venturi Effect Process Schematic



Mechanical / Combined Mixing Process Schematic



IDEAL MIXING SCHEME

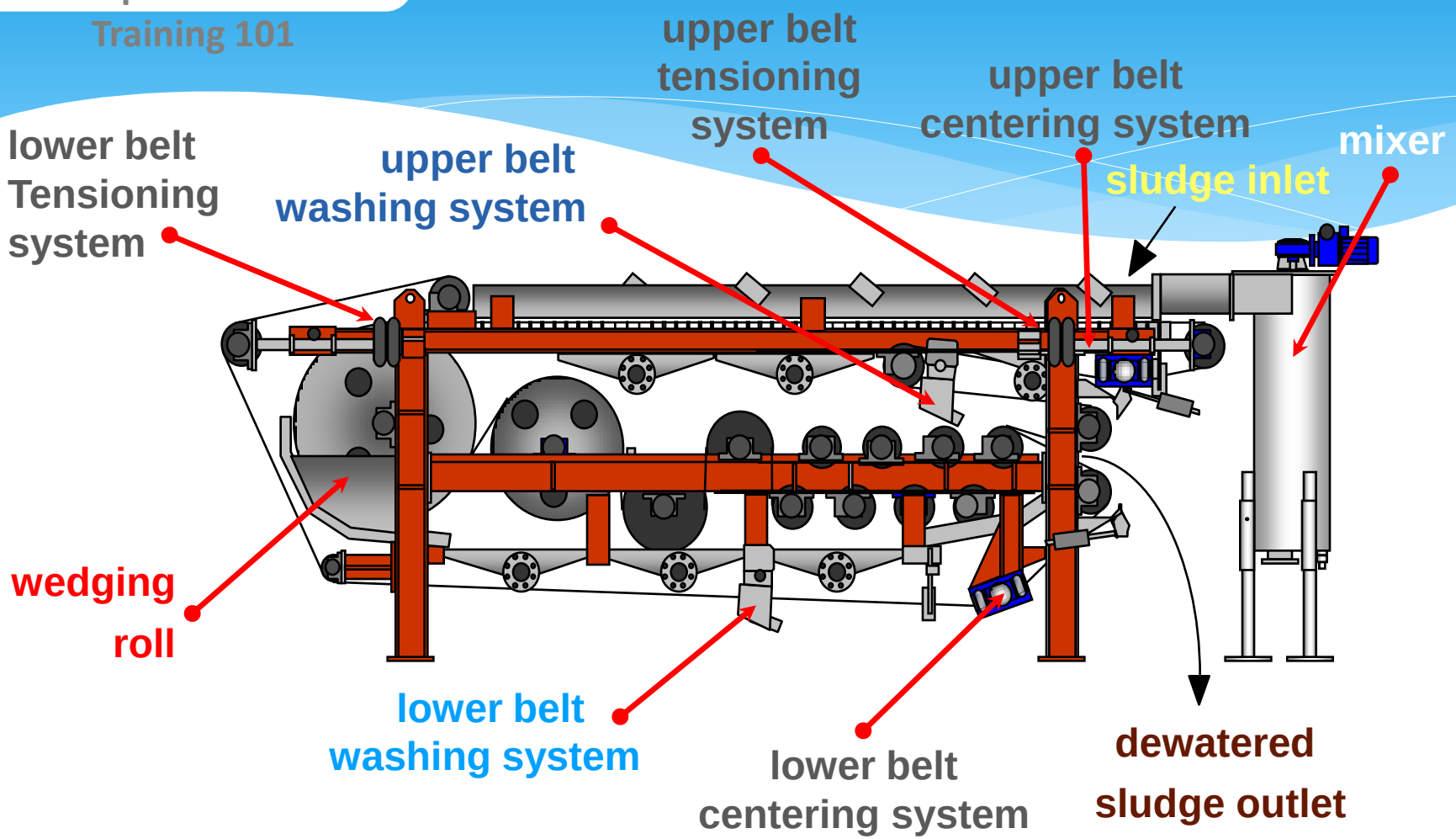



PYREX
1L
800
600
400
200

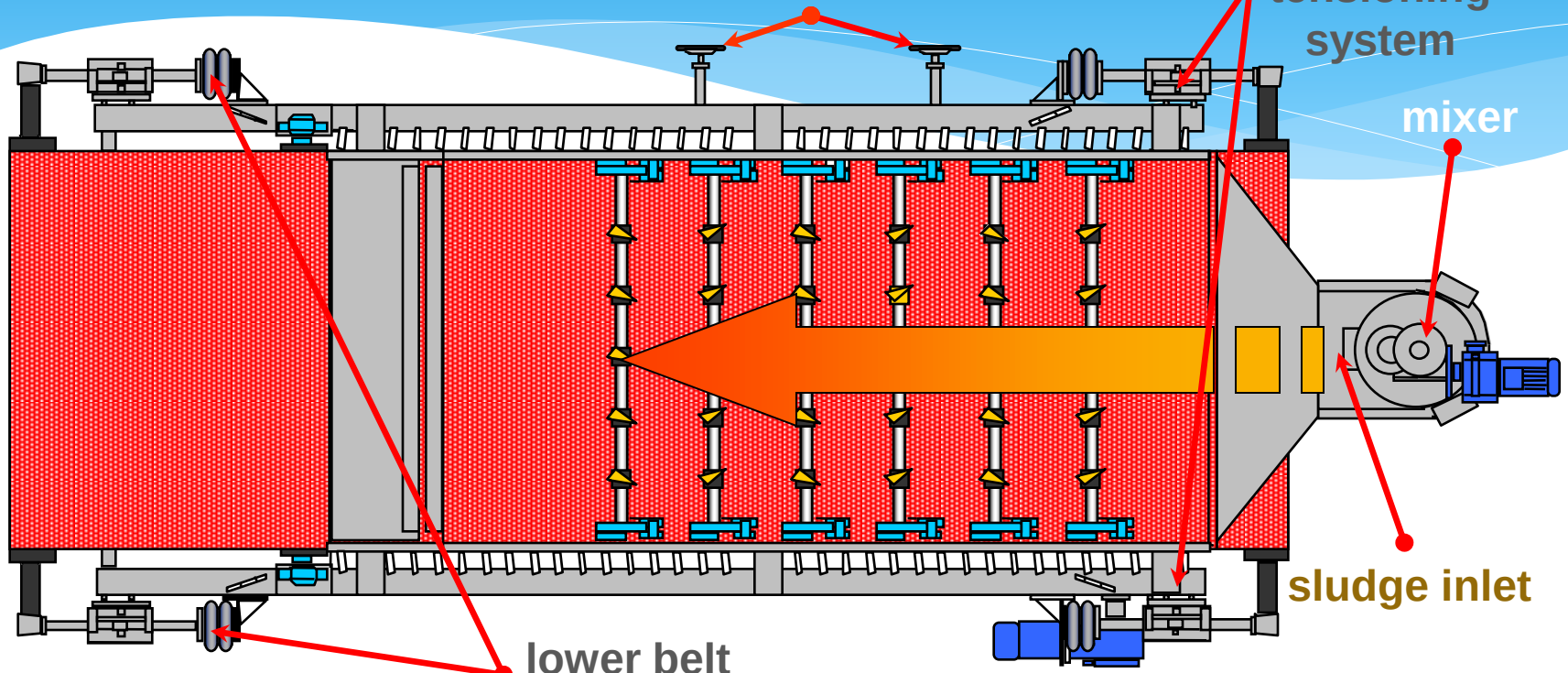
Gravity Zone Function

- **Distribution**
- **Drainage**
  - **Plows**
  - **Support grids**

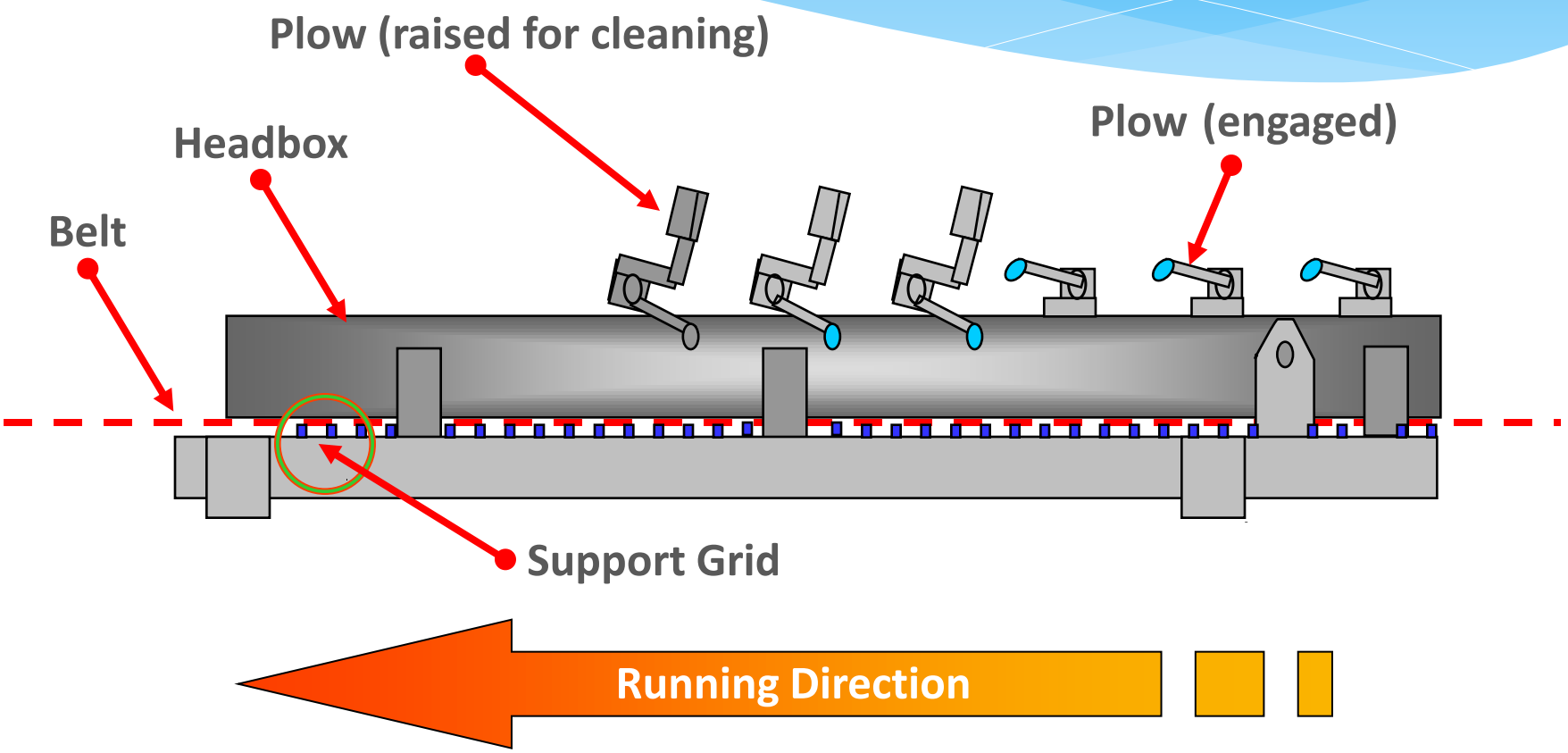
Belt Press Side View



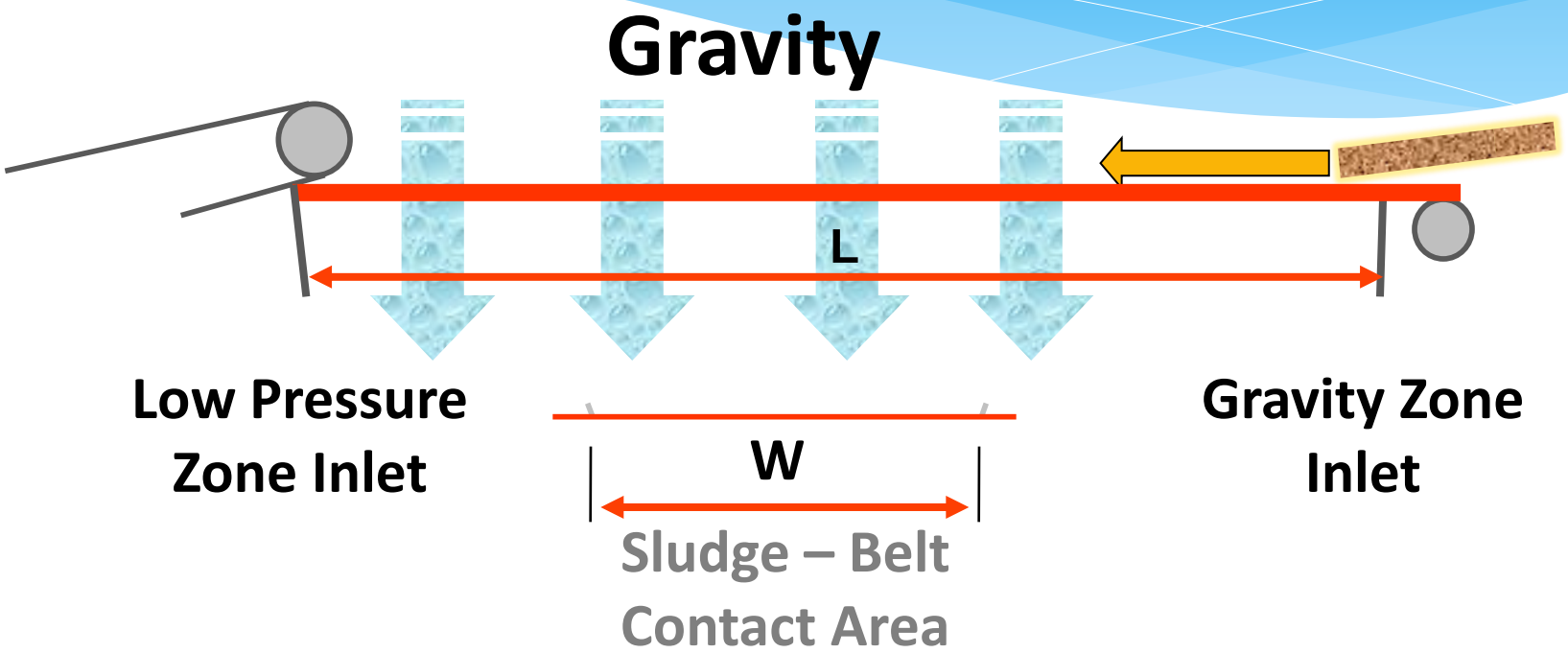
Belt Press Top View



Gravity Zone Nomenclature

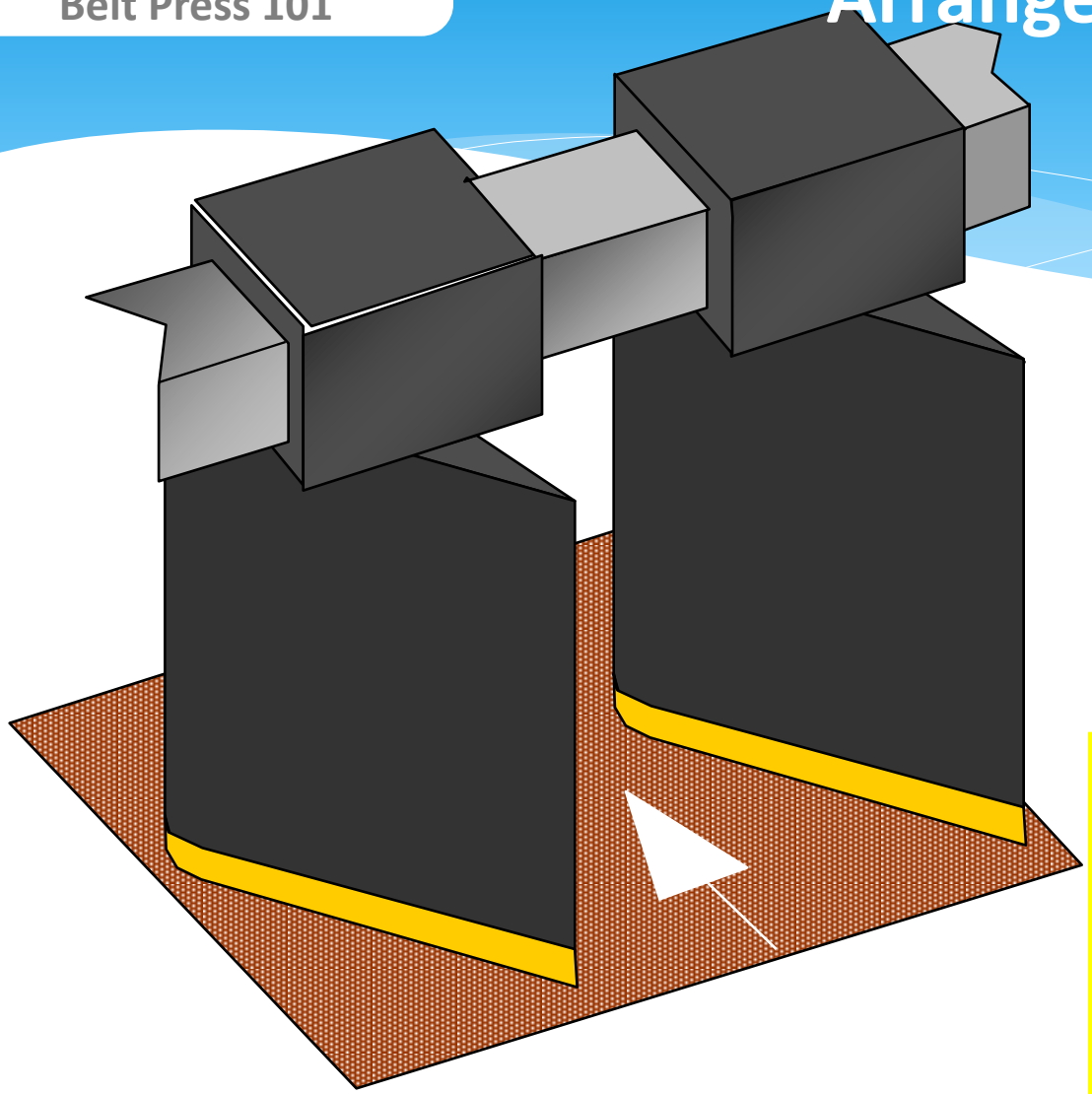


Gravity Zone

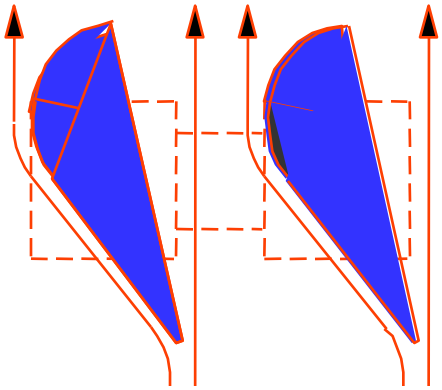


Gravity Area (ft2) = L x W

Thickening Plows Series Arrangement



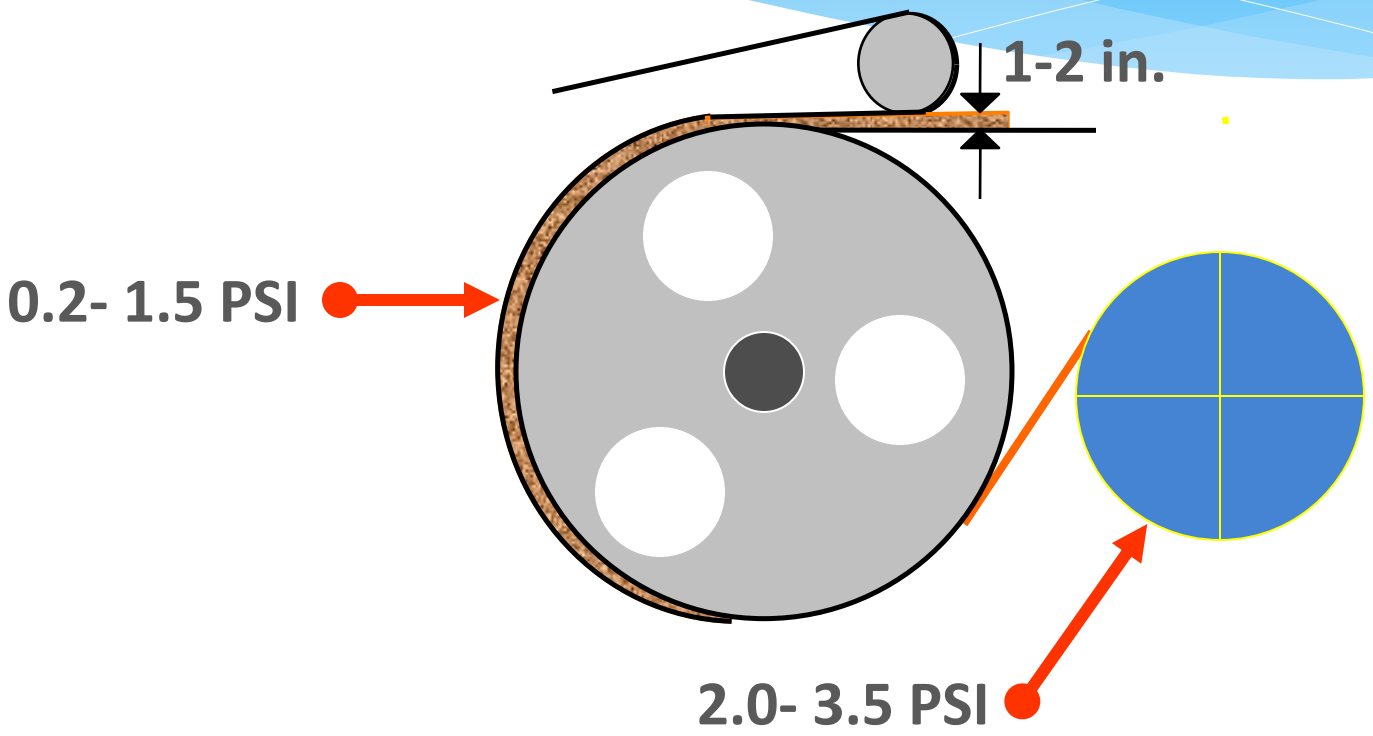
WATER DRAINING ZONE



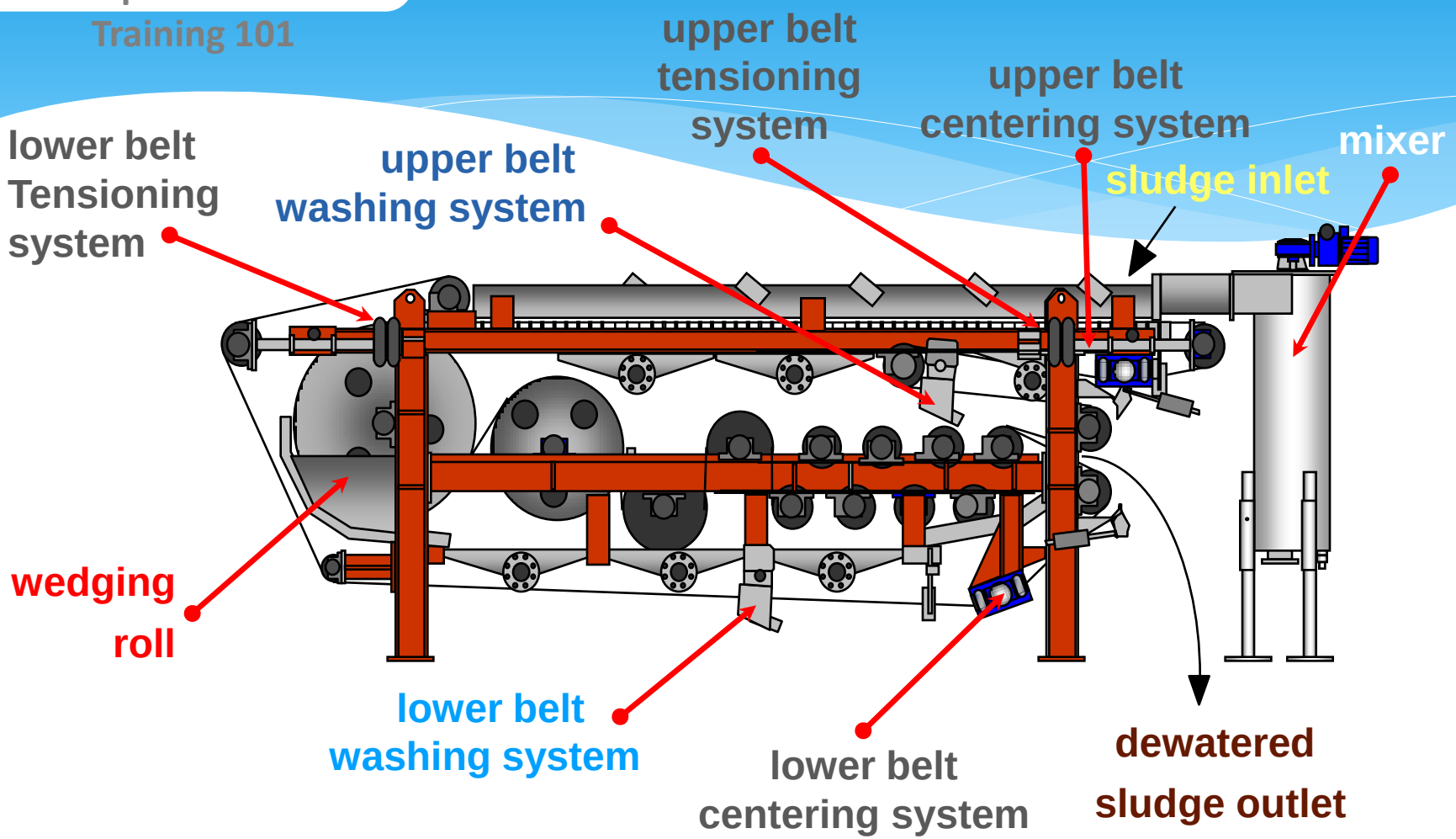
Low Pressure / Wedge Function

- **Provide a transitional pressure**
  - **>Atmospheric ~ 0.0**
  - **<1st high pressure roller- 1.5 PSI**

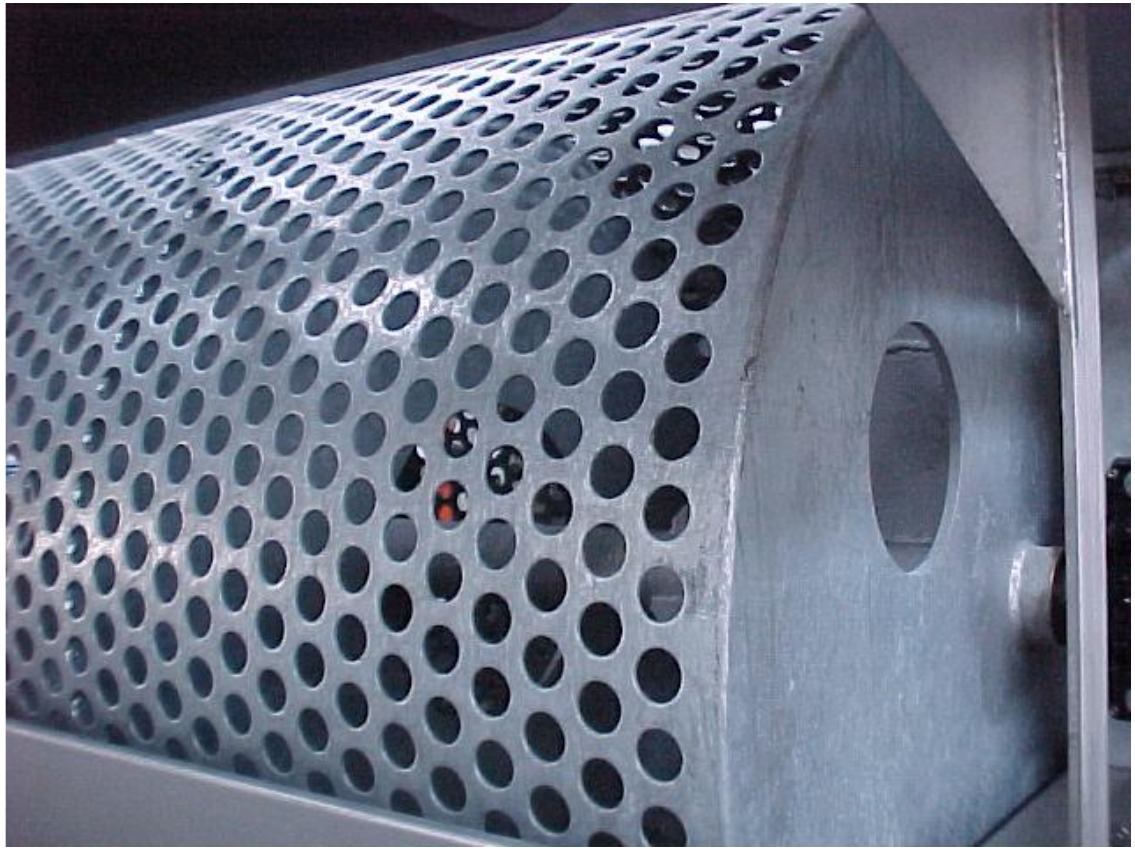
Rolling Radial Wedge



Belt Press Side View

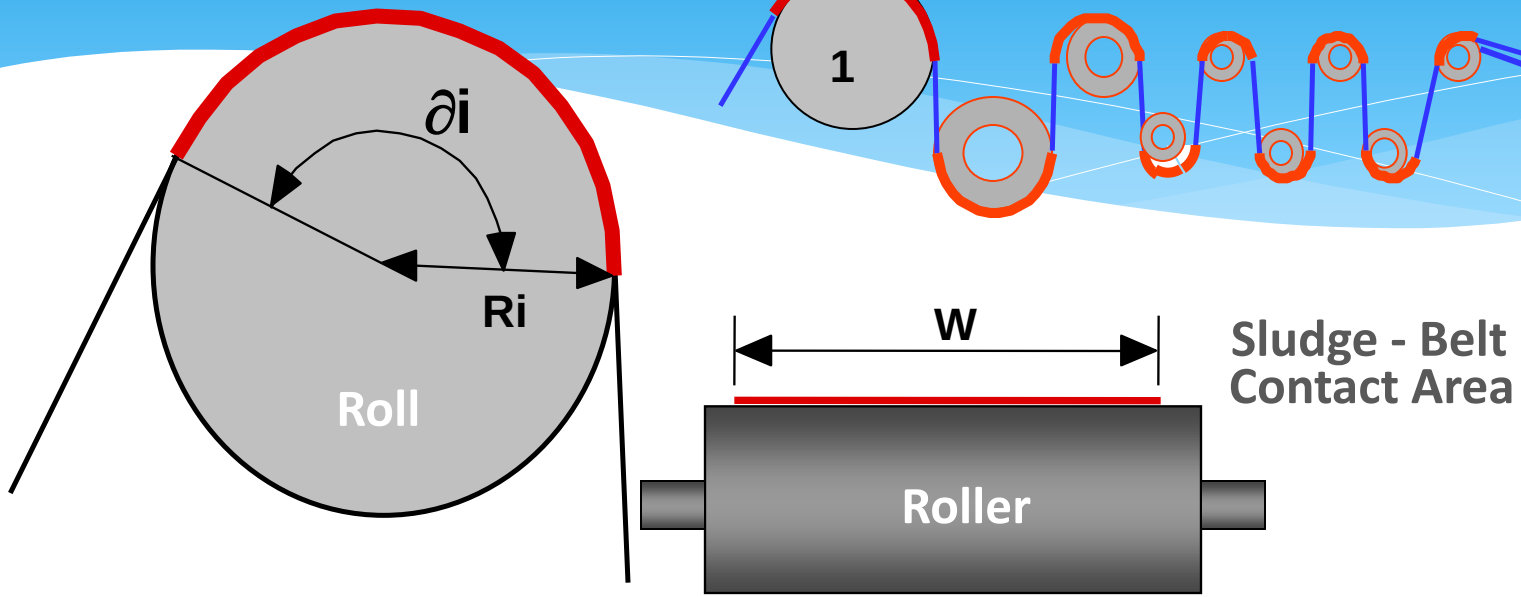


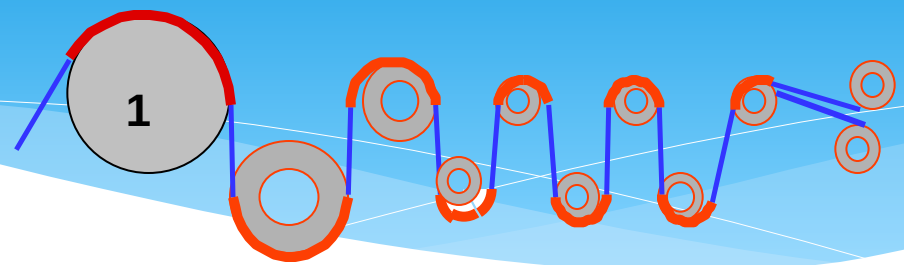
Perforated Roller



Belt Press 101

High Pressure Filtration Area





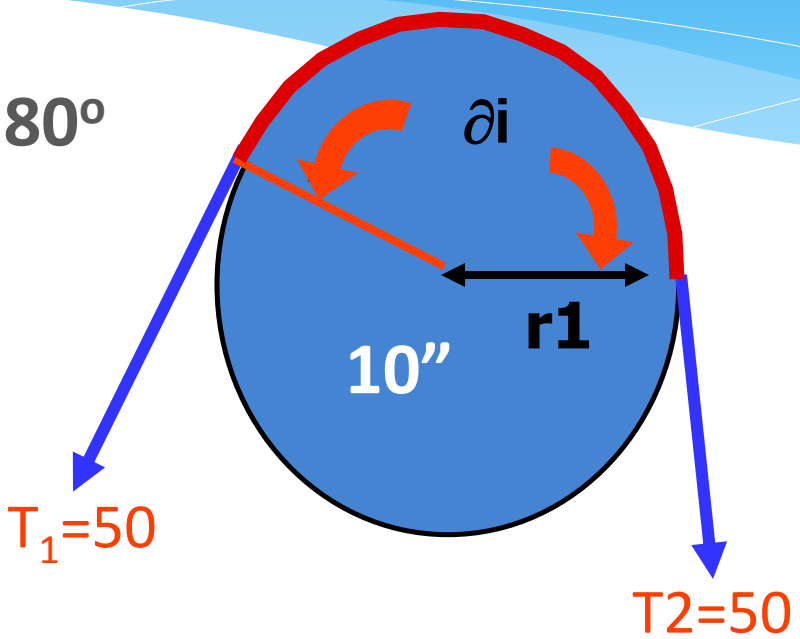
$$\text{Area} = \sum_{i=1}^{n} (2 \times Ri \times \pi \times (\partial i / 360) \times W)$$

Pressure

- **Linear**
  - **Expressed as PLI (pounds / linear inch)**
- **Area**
  - **Expressed as PSIG**

Calculating Area Pressure

$\partial i = <180^o$



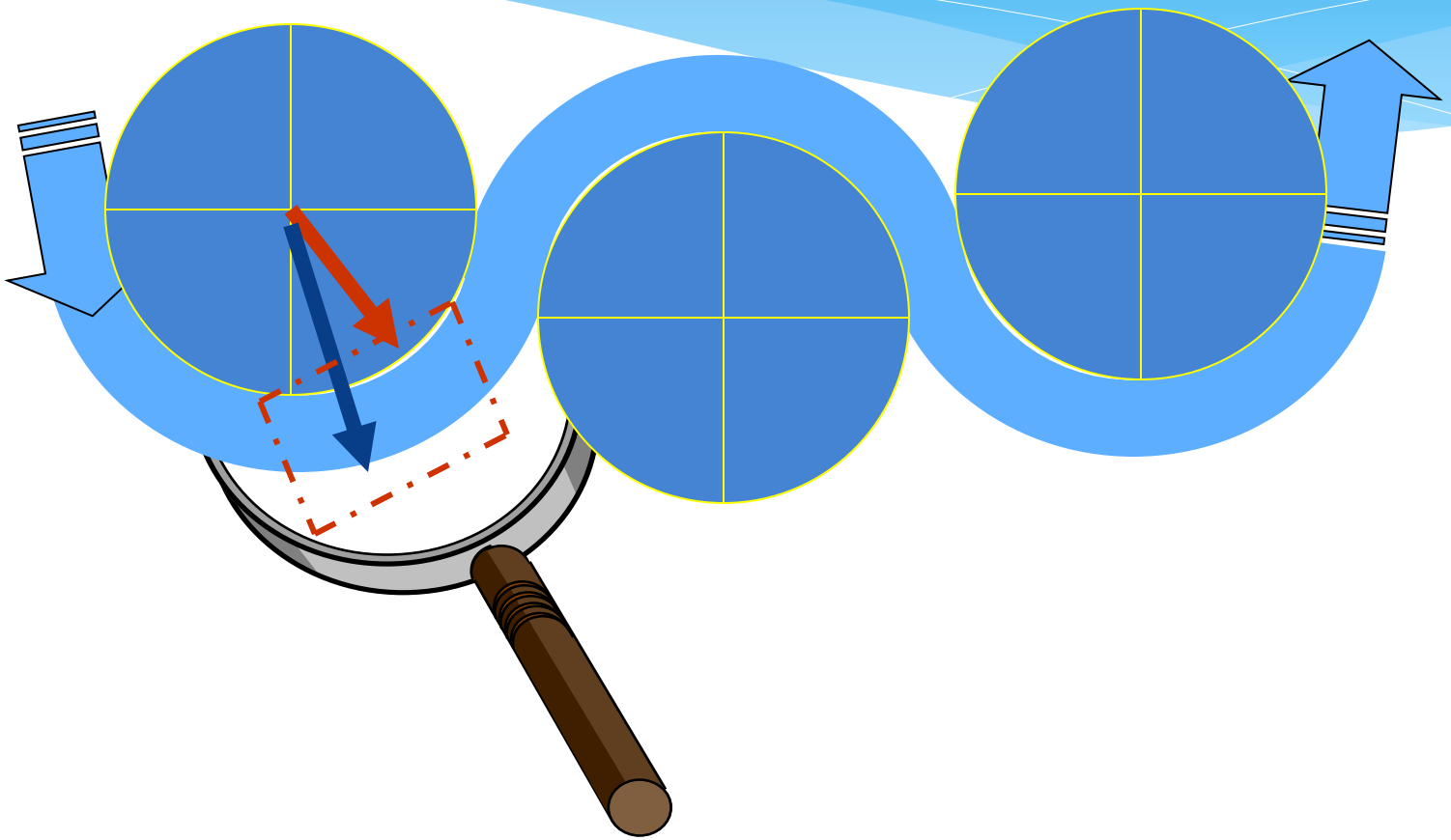
$$P_a = \frac{T_1}{r_1}$$

$$\frac{50}{5} = 10 \text{ PSI}$$

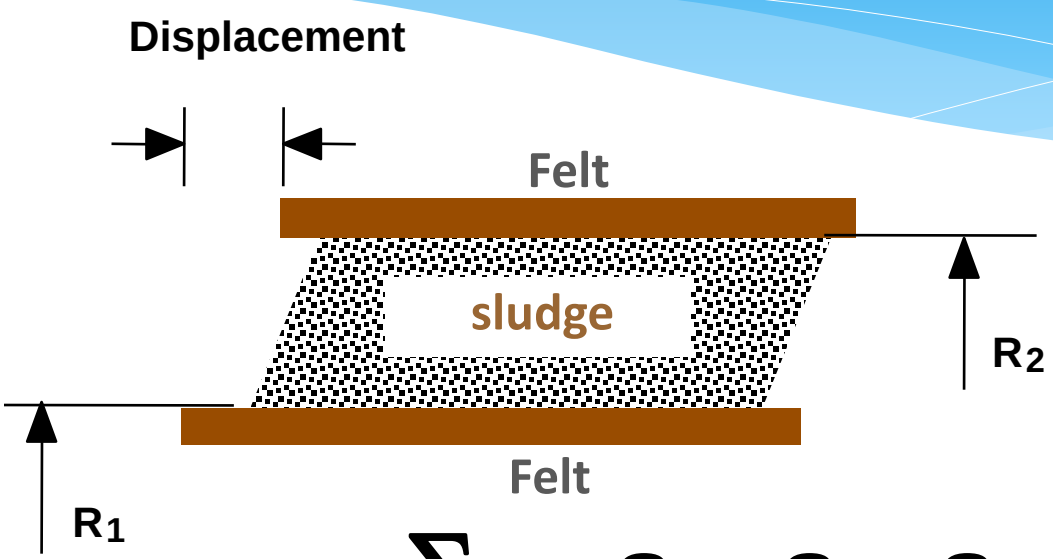
High Pressure Objectives

- Converts linear tension (PLI) to area pressure (PSI)
- Shearing forces are created as a result of differential in tangential belt speed

Shearing Force



Shearing Forces



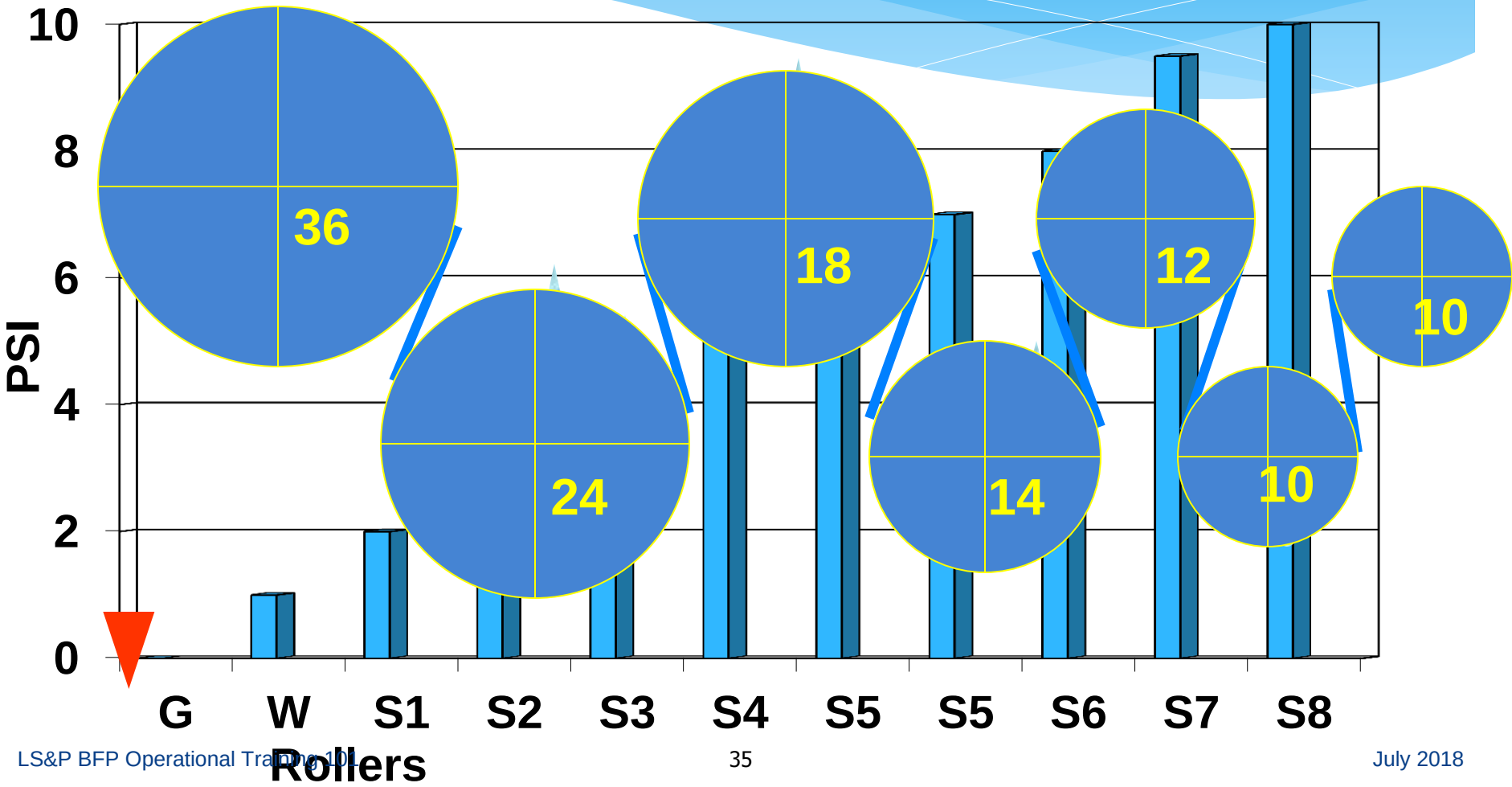
$$\Sigma = S_1 + S_2 + S_3 \ldots\ldots S_{10}$$

$$R_1 = 1205 \text{ mm}$$

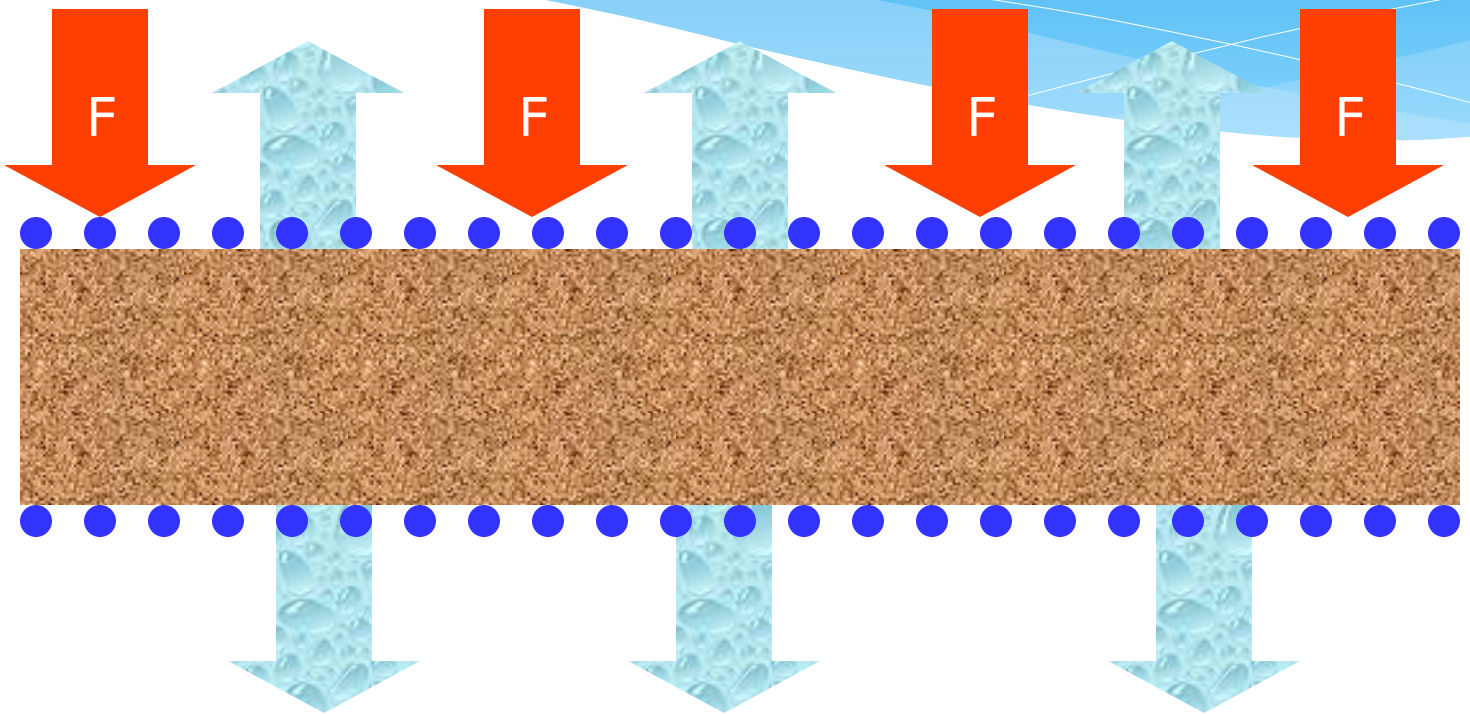
$$R_2 = R_1 + \text{Sludge thickness}$$

Belt Press 101

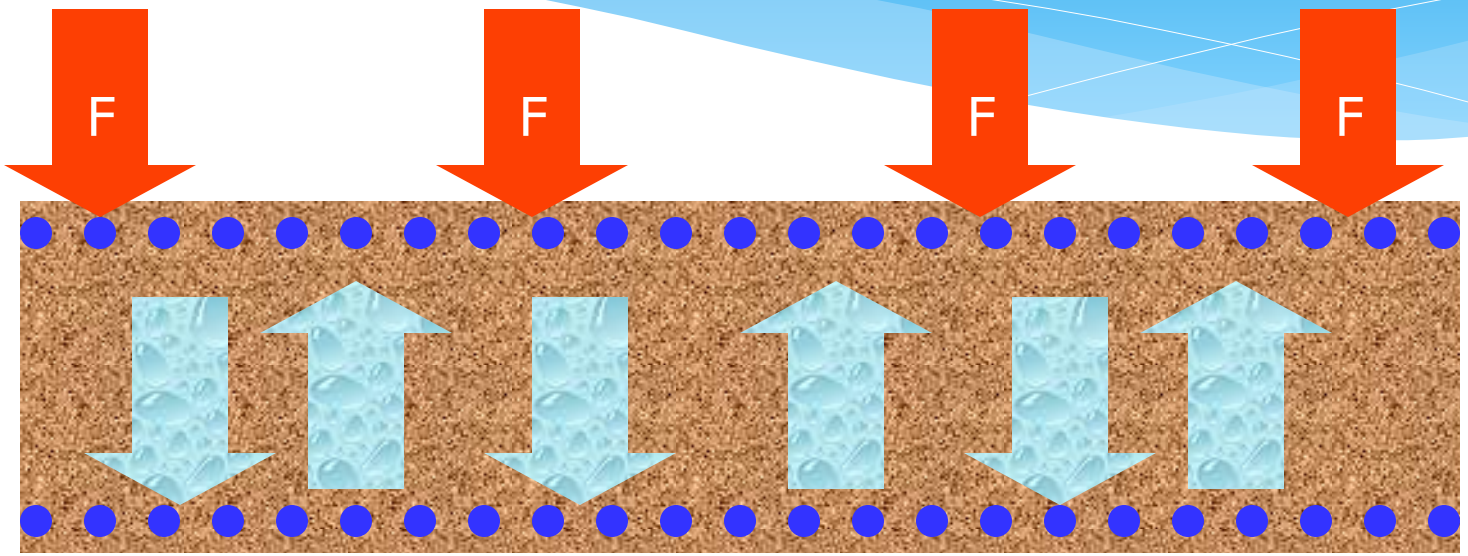
Conventional Pressure Section



Optimum Pressure

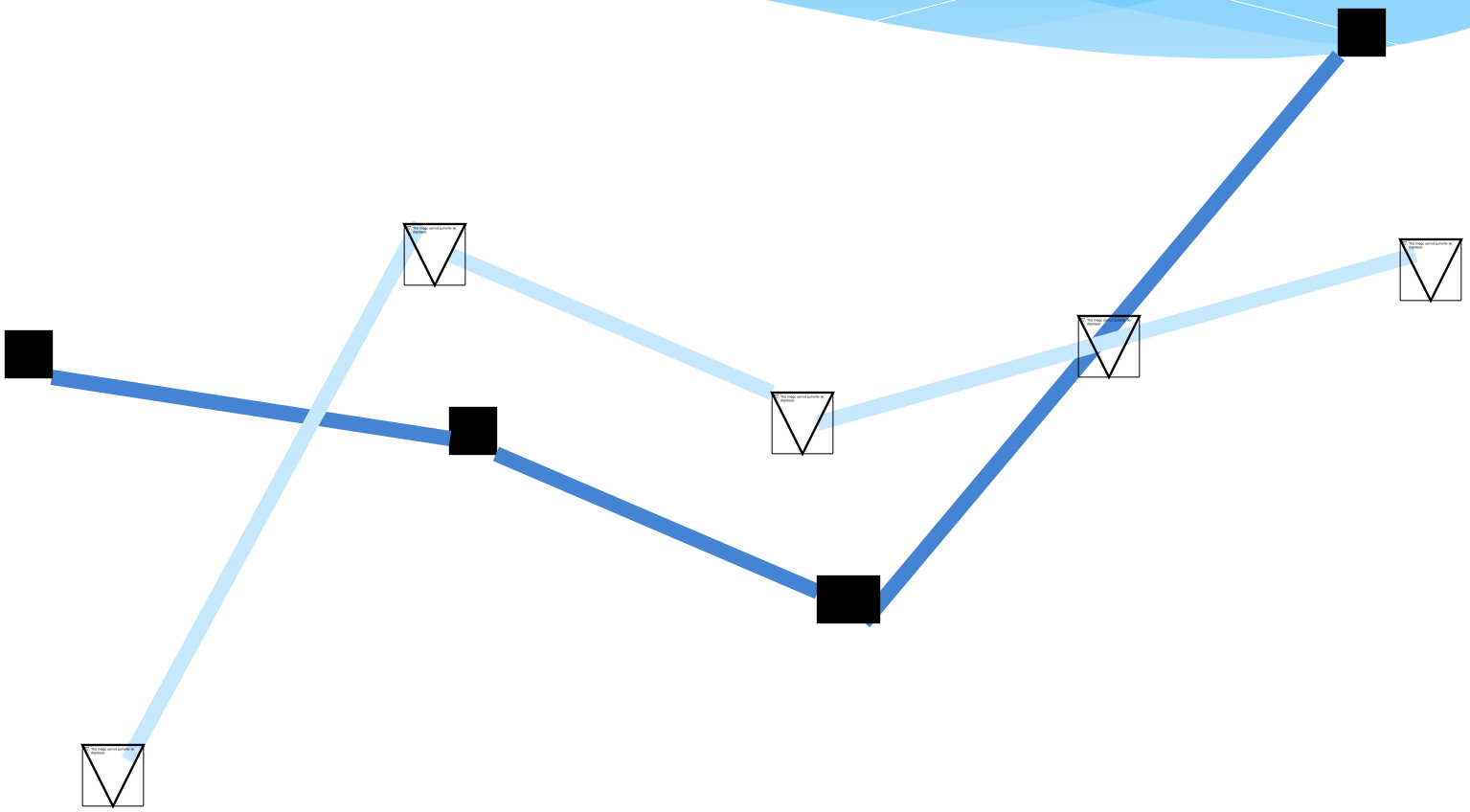


Excessive Pressure



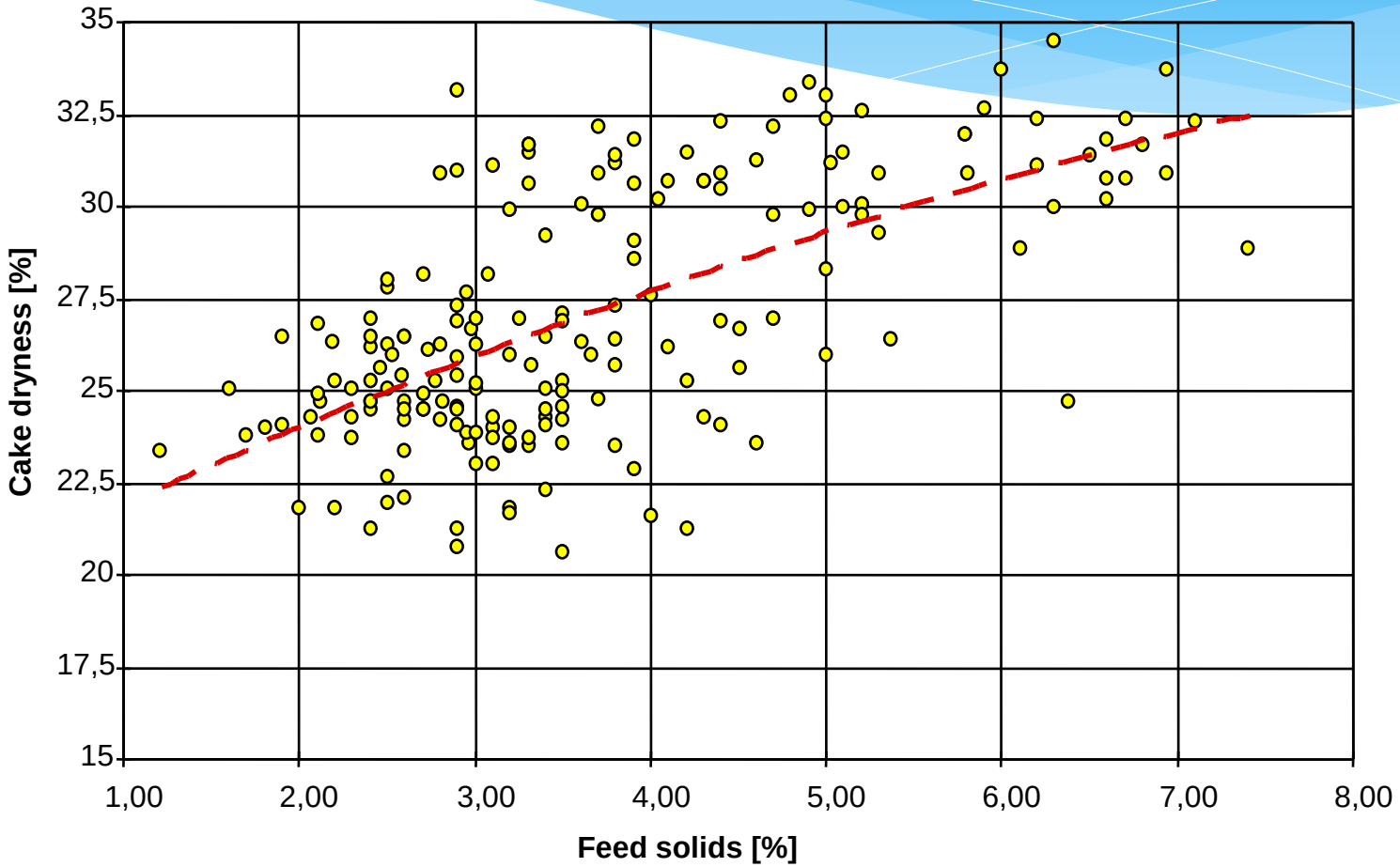
Belt Press 101

Performance Relationships

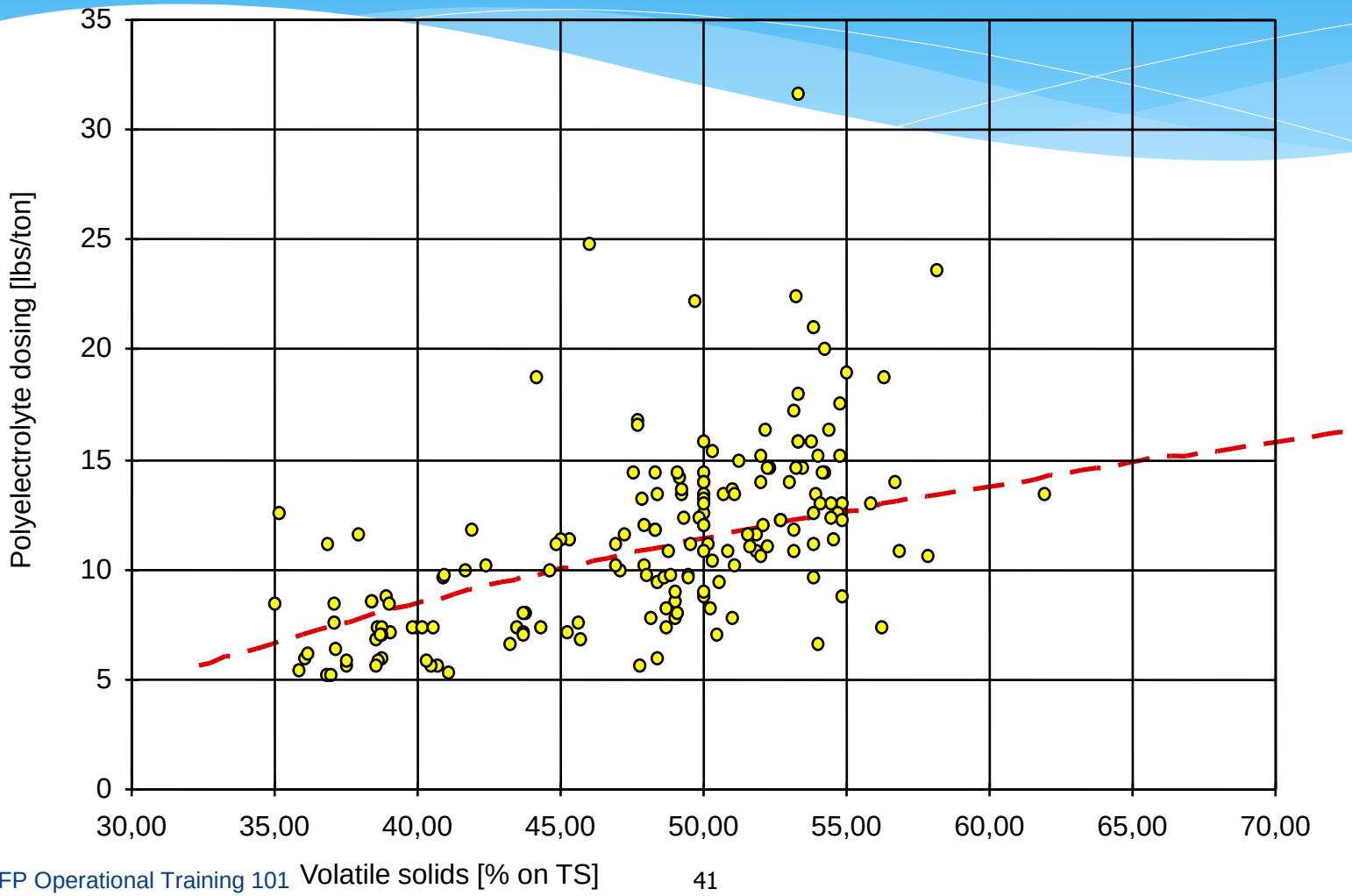


Feed Solids Vs. Cake

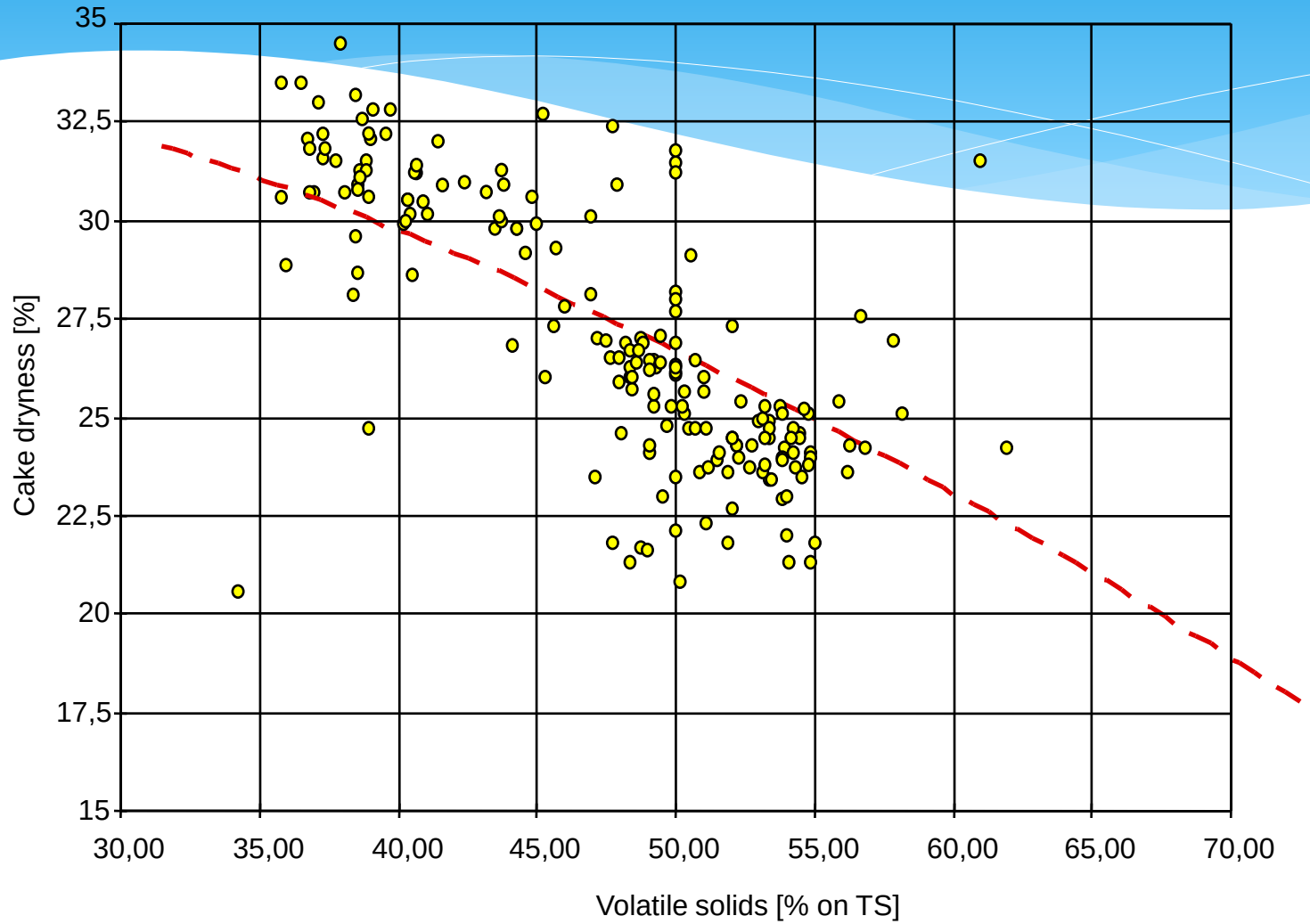
ANAEROBIC DIGESTED SLUDGE



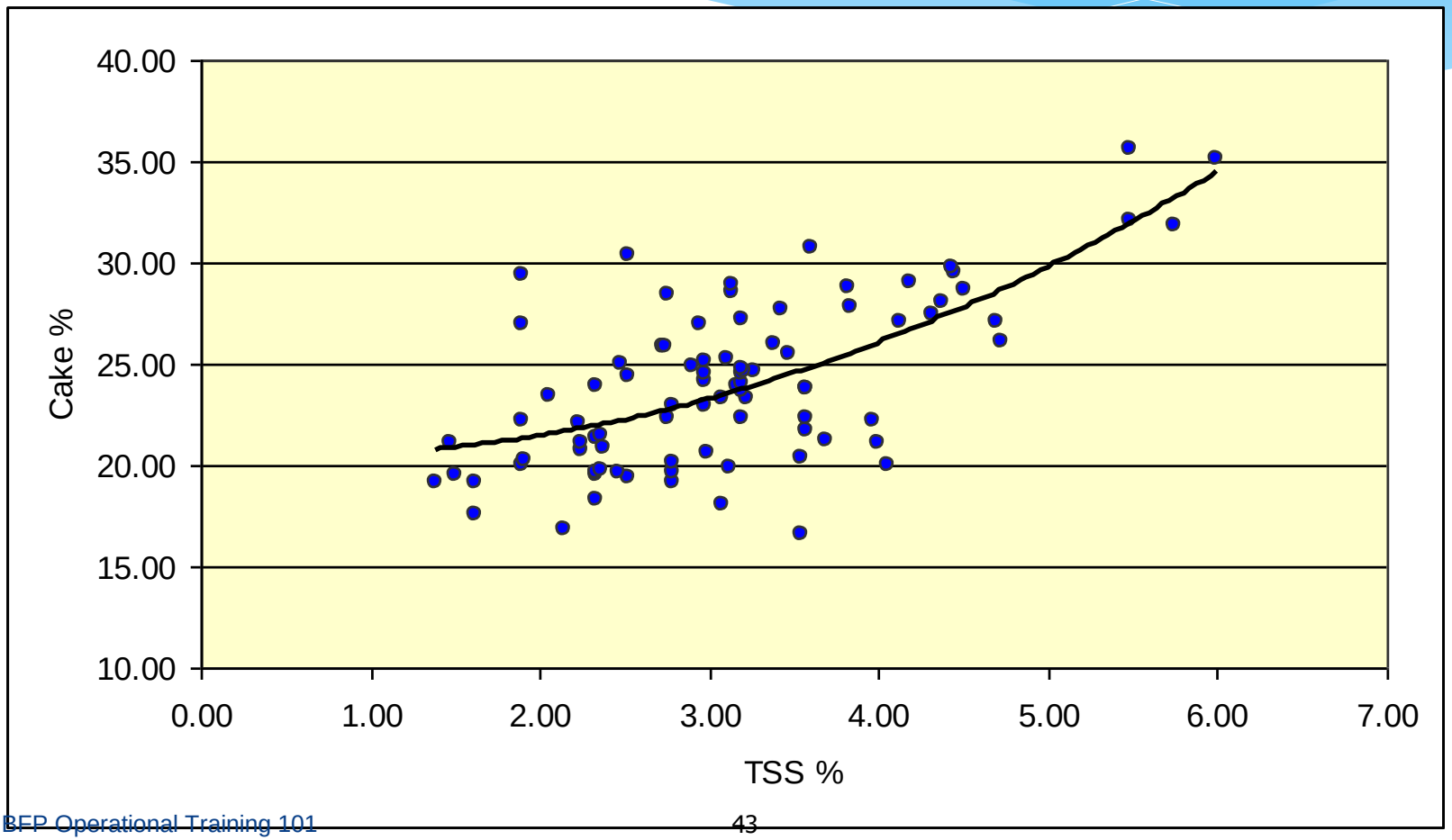
Polymer Vs. Volatile Solids



Volatile % Vs. Cake Solids

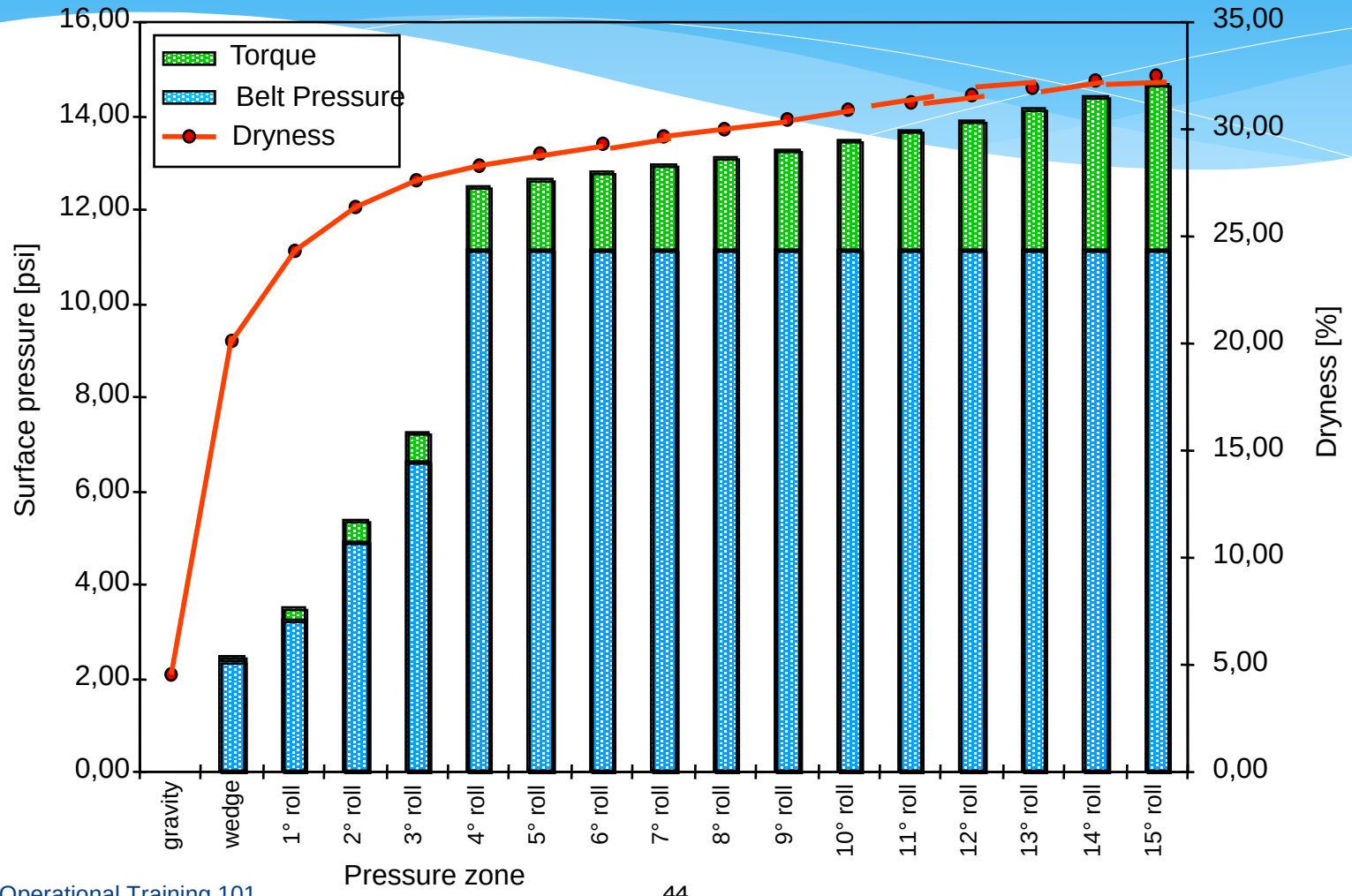


Anaerobic %Cake Solids vs %TSS

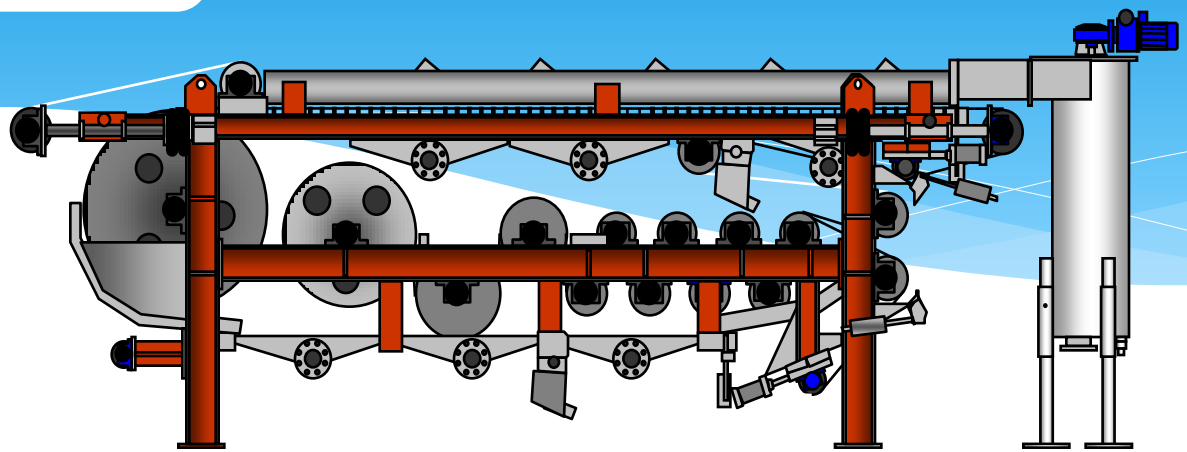


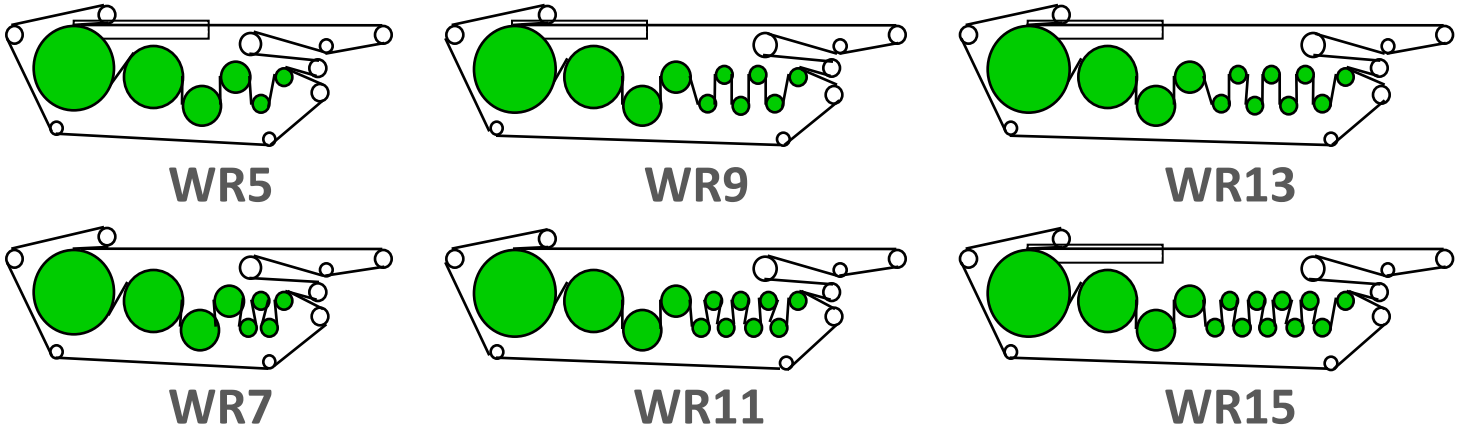
High Solids Machines

Municipal waste sludge (TSS = 4% ; VS= 65%)



Modular configuration





BELT WIDTH (M): 1.2 – 1.6 – 2.0 – 2.5 – 3.0

Wrap Angle vs. Area Pressure

- **Wrap angles greater than 180°**
  - **Increase filtration area**
  - **Decrease area pressure**

Performance Relationships

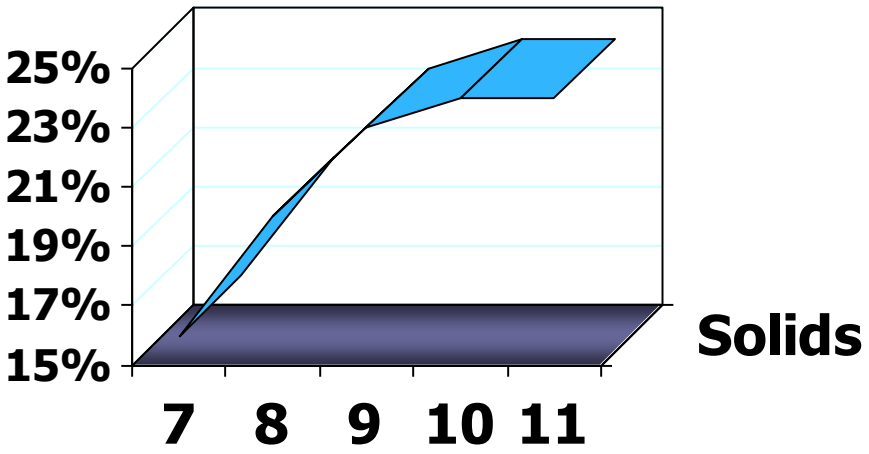
- Throughput
- Cake solids
- Polymer dosage
- Capture
- Belt speed
- Pressure

Factors Affecting Cake Solids

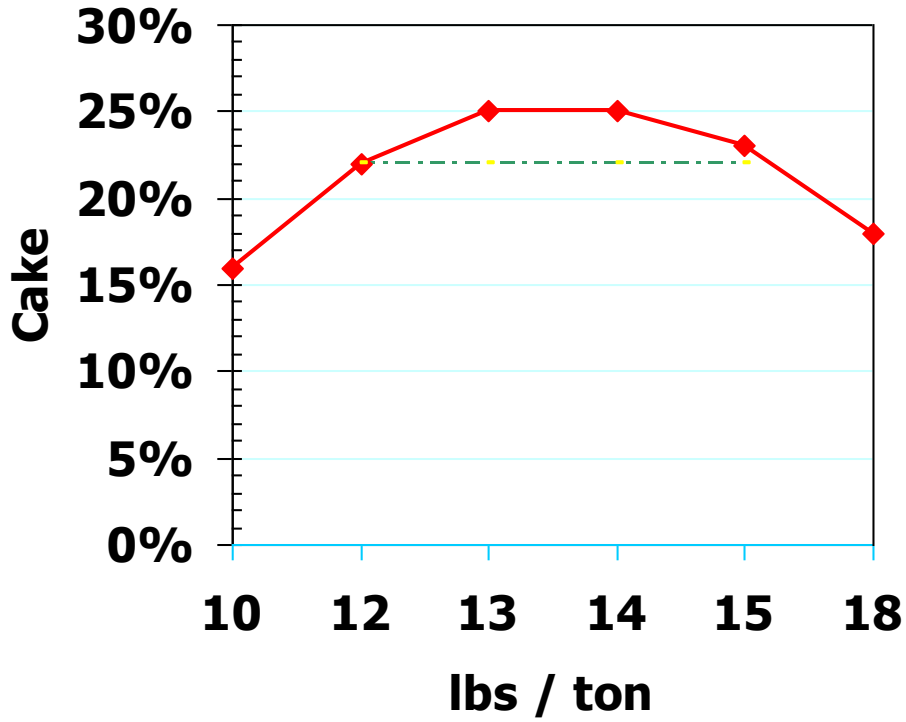
- Polymer dosage
- Detention time / belt speed
- High pressure filtration area
- Area pressure
- Cake stability

Area Pressure Vs. Cake Solids

- Diminishing returns
- Reduced capture %
- Reduced belt life



Polymer Vs Cake Solids

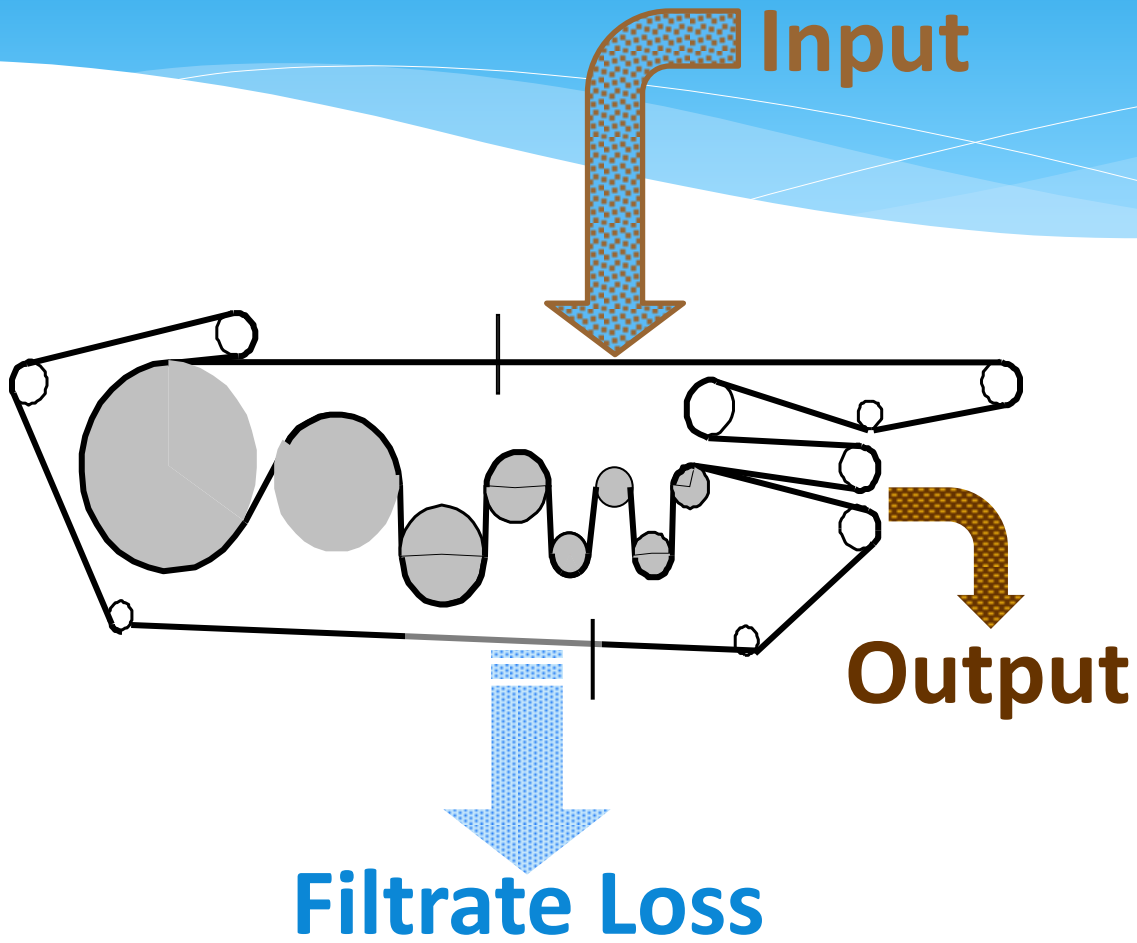


- **Dependent upon:**
  - Operator attention
  - Solids variance
  - Bandwidth

Factors Affecting Polymer Dosage

- **Static**
  - Feed suspended solids
  - Dissolved solids
  - Volatile solids concentration
  - Zeta potential
- **Dynamic**
  - Cascade effect
  - Detention
  - Mixing energy
  - Media impact

Throughput Terminology



Calculating Throughput

- **General method**
  - **Input**
- **The belt press equation**
  - **Output**
- **Mass balance**
- **Hydraulic loading vs. Solids loading**

General Input Calculation

- Q = flow rate (gpm)
- Ts = % concentration (TSS)
- Sg = specific gravity

*Throughput = Q *Sg* Ts * 500.4*

The Belt Press Equation

- W = cake width (in)
- T = cake thickness (in)
- V = belt speed (fpm)
- Cs = cake solids (%)
- Sg = specific gravity
- K = 0.26

$$Throughput = W \times T \times V \times Cs \times Sg \times K$$

Factors Affecting Throughput & Capture %

- **Throughput**
  - Belt speed
  - Cake solids
  - Effective belt width
  - Cake thickness
  - Specific gravity
- **Capture**
  - Polymer Dosage
  - Fabric Weave / Permeability
  - Proper Throughput
  - Pressure

Safety Considerations

- **CAUTION WHEN CLEANING MACHINE!**
- **<u>NEVER</u> stand on side beams when operating**
- **<u>NEVER</u> place hands inside operating machine**
- **Verify Function of Tag Lines**
- **<u>NEVER WORK ON ACTIVE MACHINE</u>!**

Questions or Comments

Contact Langley Separation and Process

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