Belt Press Optimization

OWEA

Biosolids Specialty Workshop

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Agenda

- **Belt Press Overview**
- **Optimization Parameters**
- **Focus on Solids Capture**
- **Why Does it Matter?**
- **Ways to Improve Solids Capture**
- **Specifics to Belt Press Technology**

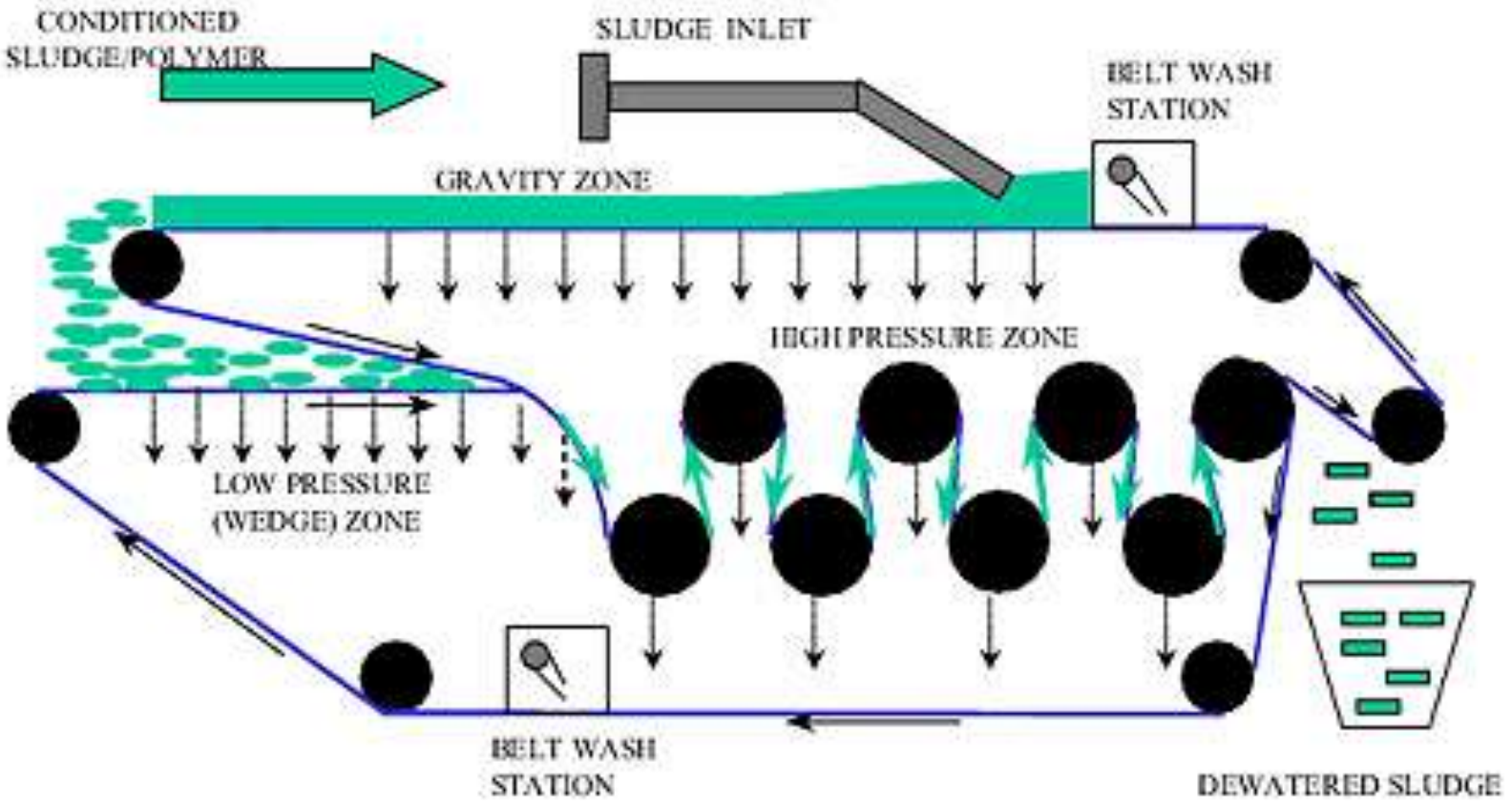
Belt Press Overview

Three primary zones:

- **Gravity: A cake begins to form**
- **Wedge: Formed cake is sandwiched between two filter cloths and low squeeze pressure applied.**
- **Pressure: High pressure and shear applied by serpentine path of two belts around a series of rolls.**

Belt Press Schematic

Image source: www.ashbrookcorp.com



Gravity Zone Design

- **Cake Formation**
  - **Initially no cake when the feed slurry is placed on the filter cloth.**
  - **As slurry flows through filter cloth, solids deposit on surface**
  - **Resistance to filtrate flow increases with time exponentially.**
  - **Increasing the belt speed improves the thickening by spreading the cake over more area, producing a thinner cake, and significantly reducing flow resistance.**
  - **Plows: Enhance filtrate flow by dislodging deposited solids, provide compression by kneading**
  - **Example: 300gpm of Feed at 2% → 3,000 lb/hr dry**

Calculation: Filtrate Flow

- **300gpm * 0.02 = 6gpm (of *solids*)**
- **Assume 5.5% solids by end of gravity deck**
- **6gpm/0.055 = 109gpm**
- **Or -- 6/109 = 5.5%**
- **300gpm – 109gpm = 191gpm thru gravity belt**

Calculation continued…

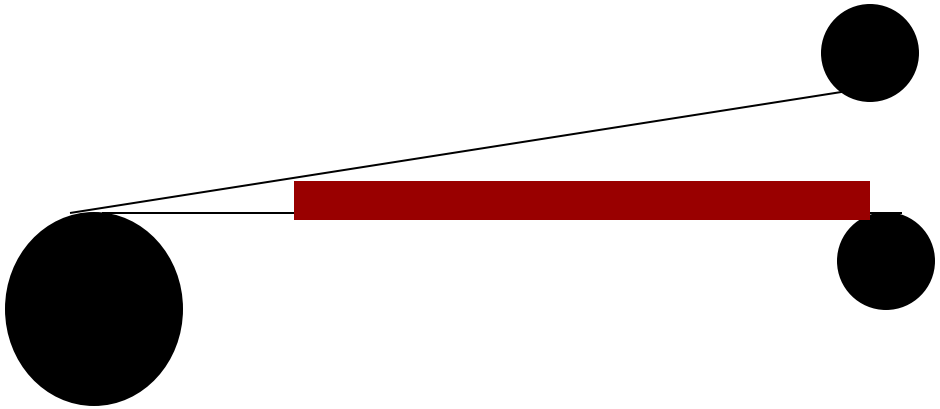
- **Remember 191gpm thru gravity belt**
- **Final cake at 20% solids**
- **6gpm/0.2 = 30gpm of discharge cake**
- **Or -- 6/30 = 20%**
- **109gpm – 30gpm = 79gpm from press**
- **Gravity Section is the Key to Capacity**

Wedge Section Design

- **Formed cake is encapsulated between belts.**
- **Consolidates loosely packed solid particles.**
- **Gradual increase in cake pressure from zero pressure to that of the first roll.**

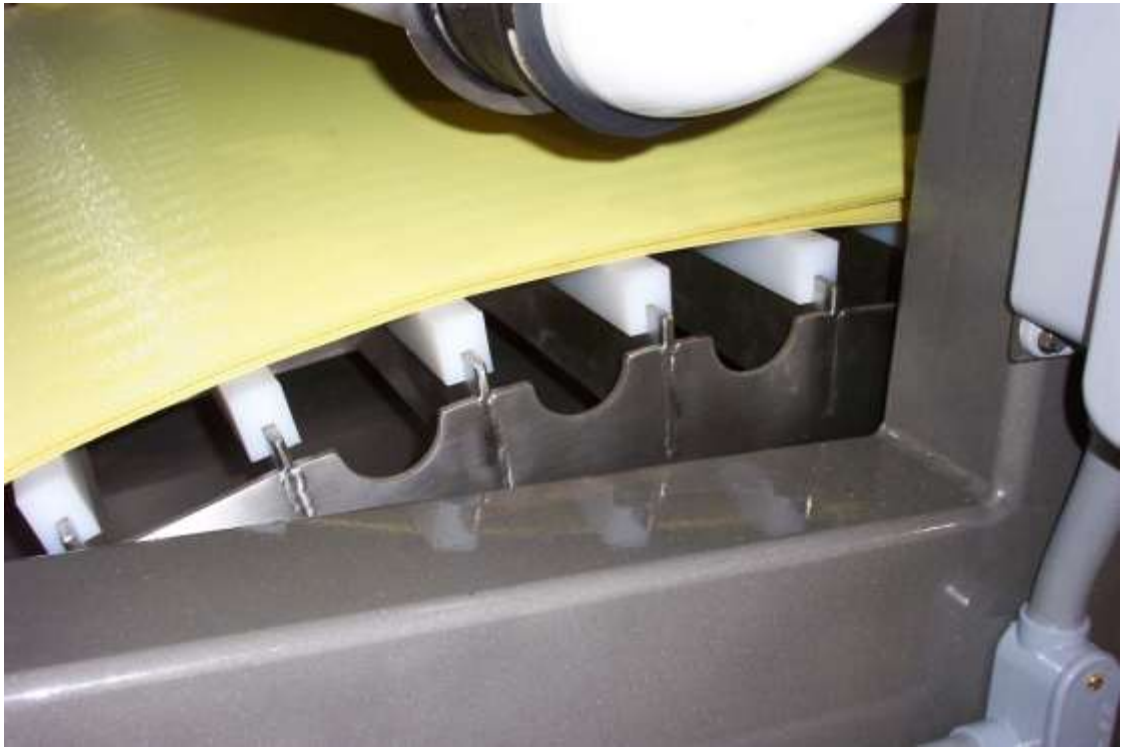
Wedge Section Design

Straight Wedge

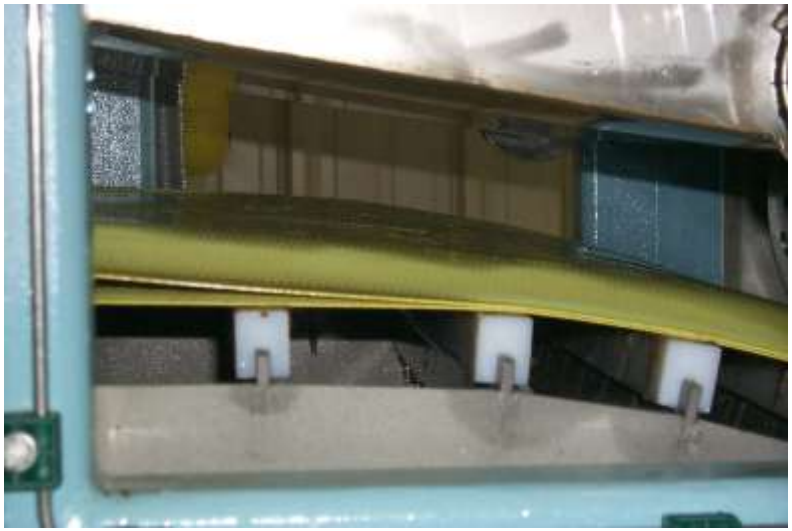


Wedge Section Design

Curved Wedge Zone



CURVED WEDGE IN ACTION

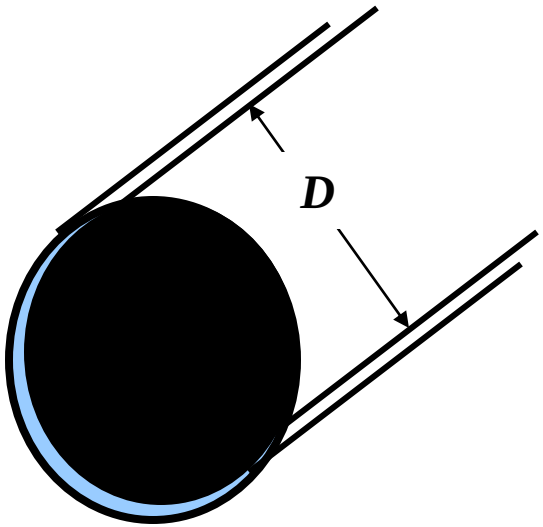


- **ENCAPSULATES EDGE OF BELT**
- **ELIMINATES WASH OUT OF SOLIDS**

Pressure Zone

- **Cake thickness is relatively fixed, so the resistance to expressed filtrate is relatively fixed.**
- **Longer time under pressure means more liquid is expressed.**
- **Slower belt speed enhances performance.**

Pressure Section Design



*Pressure = (2T*W) / D*π*W * (R/360)*

=2T/Dπ(R/360)

Where: T = Belt Tension

W= Belt Width

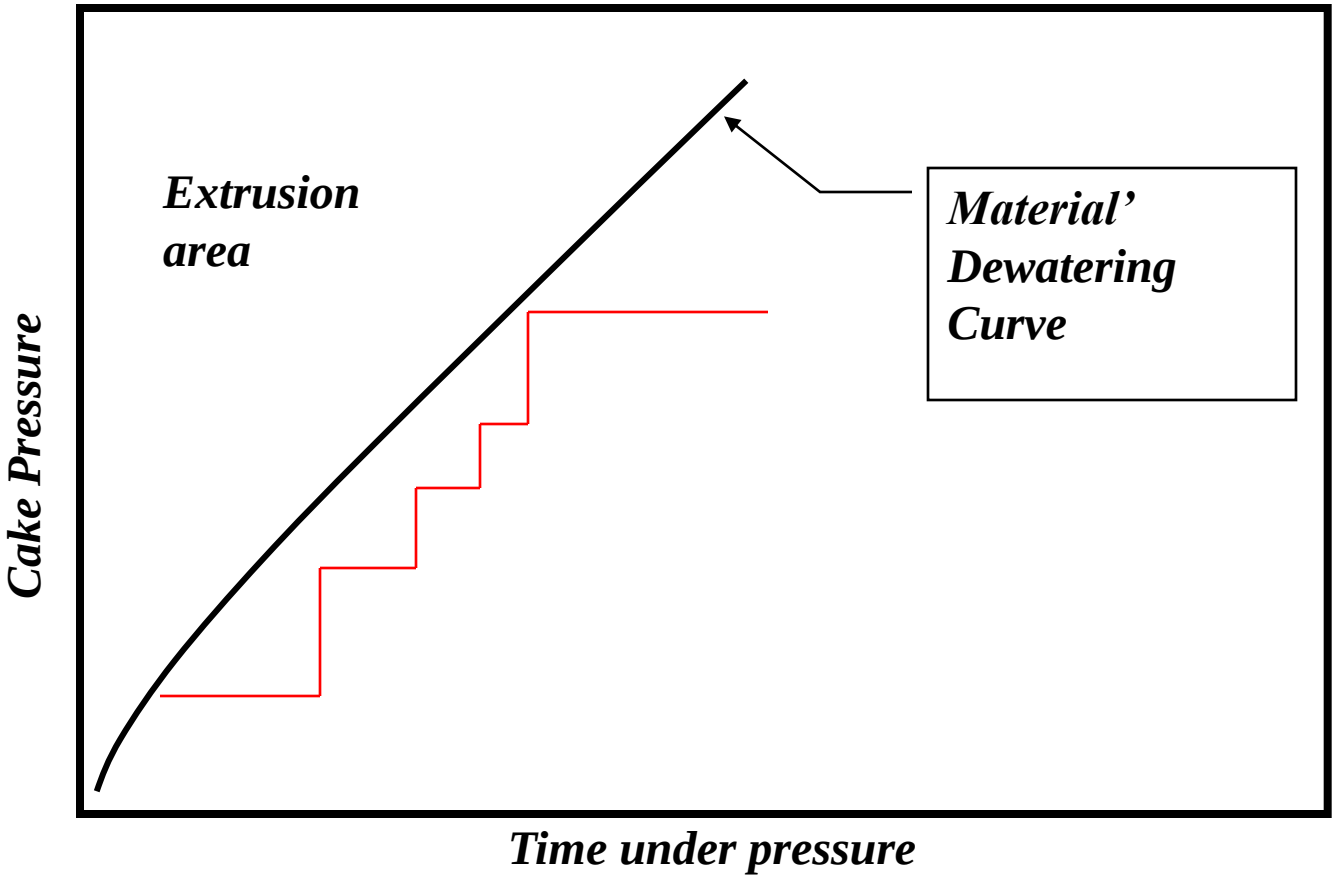
D= Roll Diameter

R= Degrees of roll wrap

Notice outer belt has longer belt path than inside belt

Pressure on cake is inversely proportional to roll diameter

Pressure Section Design



Pressure Section Design

- **Number of Rolls: More rolls, more time under pressure; but higher shear and reduced belt life.**
- **Diameter of Rolls: Decrease in diameter.**
- **Number of Perforated Rolls**
- **Roll Construction: Rigid**
- **Roll Coating: Reduce wear on belt.**

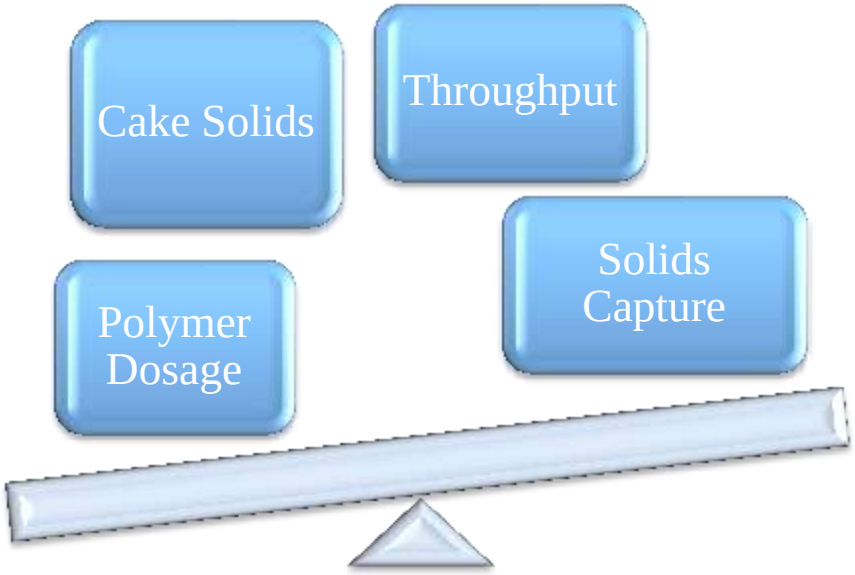
Optimization Parameters

- **Hydraulic Loading – gpm**
- **Solids Loading or Throughput – lb/hr**
- **Chemical Dosage – lb / dry ton**
- **Discharge Cake Solids – %wt**
- **Solids Capture – %**

Optimization Parameters

Balancing

Act



Focus on Solids Capture

- **Most overlooked parameter**
- **Run clean first, then improve other parameters**
- **Often leads to improvement in other parameters**
- **Shapowie!!**
  - **Clean release – belts clean before showers**
  - **No build-up on rollers**
  - **Clearest possible filtrate**

Why Does it Matter?

- **Poor Performance can be 80%, or as low as 60% Solids Capture**
- **Filtrate often returned to head of plant**
- **Significant load**
  - **Ratio to wwtp size**
  - **Expensive**
- **Running “dirty” – problems for press**

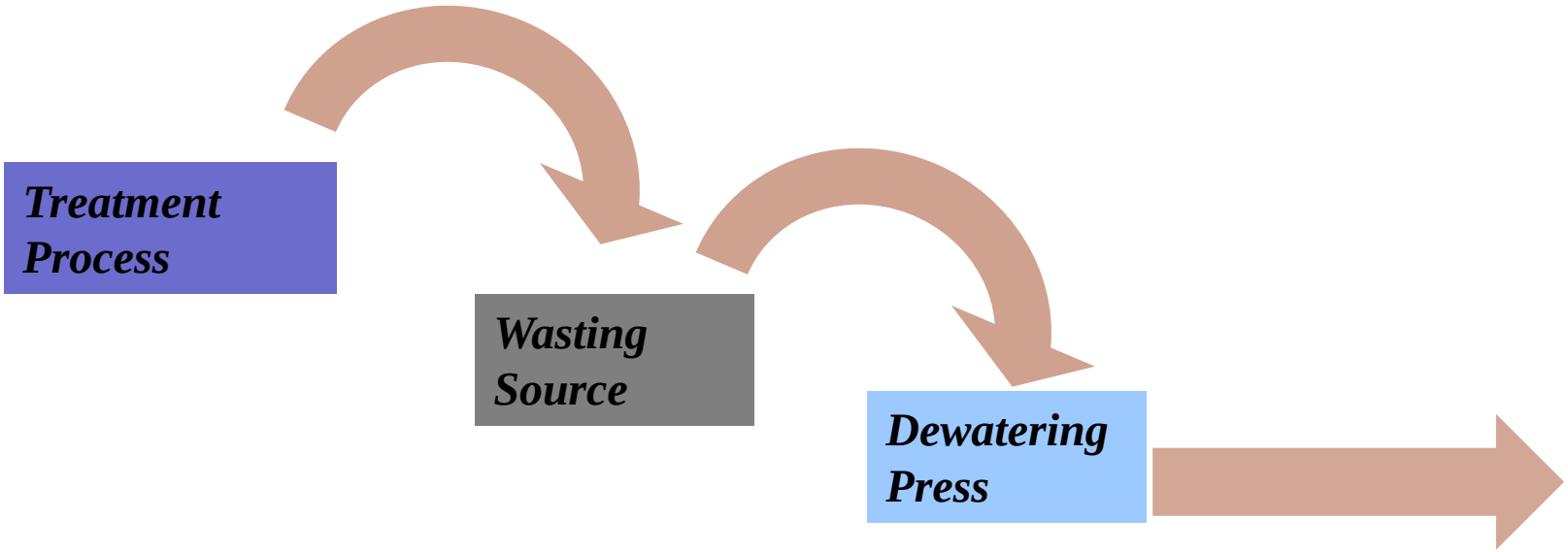
I Want Numbers

Plant Information	**VALUE**	**VALUE**	**VALUE**	**UNITS**
Average Plant Flow	1	3	10	MGD
Yearly Sludge	150	450	1500	Dry Tons per Year
Solids Throughput - Yearly	300000	900000	3000000	Dry Pounds per Year
Solids Throughput - Weekly	5769	17308	57692	Dry Pounds per Week
Solids Capture	**VALUE**	**VALUE**	**VALUE**	**UNITS**
Recycled at 60% capture	120,000	360,000	1,200,000	lbs returned to head of plant (yr)
Recycled at 80% capture	60,000	180,000	600,000	lbs returned to head of plant (yr)
Recycled at 98% capture	6,000	18,000	60,000	lbs returned to head of plant (yr)

Numbers Aren't My Thing

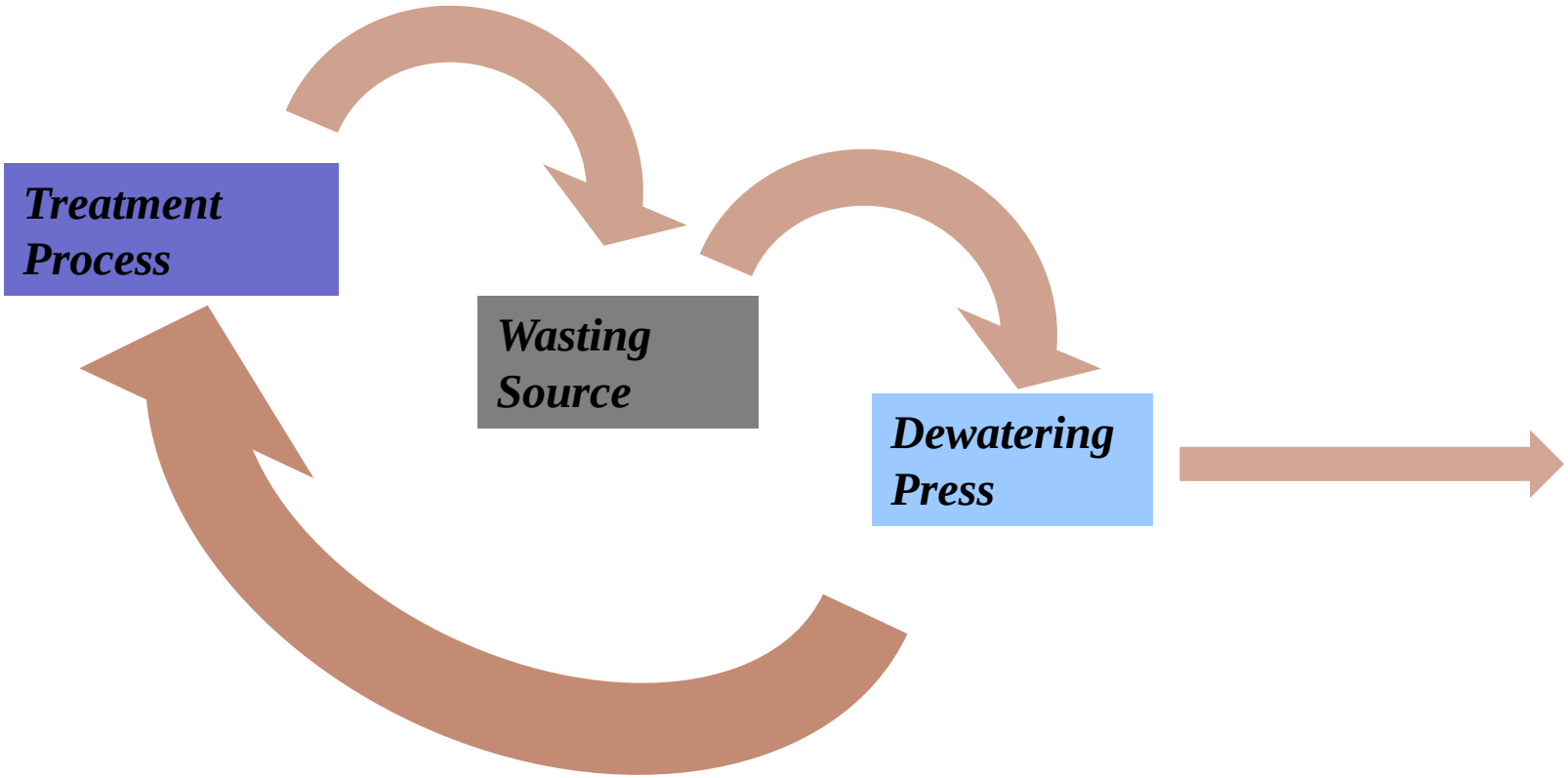
- Car Wash
- Mop The Floor
  - Imagine half of the grime decides to stay
  - Accumulation
- Toughest stuff to capture, fines

Trace The Solids Path



Low Solids Capture

Hey, That's a Loop



Low Solids Capture

Dirty Filtrate

Catch Me Running Dirty

- **Belt Looping**
- **Belt Wrinkles and Stretching**
- **Increased Maintenance**
  - **Slide Strips**
  - **Rollers**
  - **Belts**
- **Should Not Need to Hose That Often**

Belt Looping

Belts Stretched Unevenly

Poor Distribution

Shapowie – Aerobic Version

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Shapowie – Anaerobic Style

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Ways to Improve

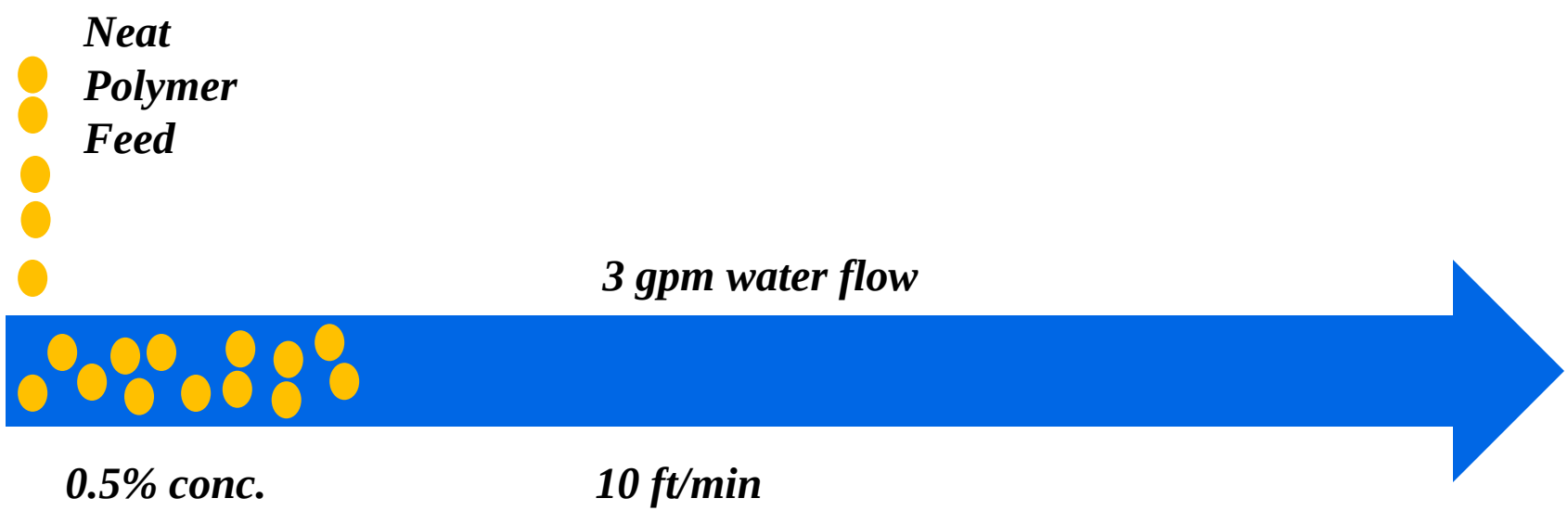
- **Polymer**
  - **Newer, jazzy polymers. Cross-linked, high MW**
  - **Proper activation & dilution**
- **Consistency to the Press**
- **Remove Variables Whenever Possible**
- **Take it Step by Step**
- **Specific Belt Press Notes**

Emulsion Polymer Unit

- Check Inlet Water Pressure
- Check Mixing in Chamber
- Check Concentration
- Flooded Suction

Fluctuating Water Pressure

- **Worse than you think**



Fluctuating Water Pressure

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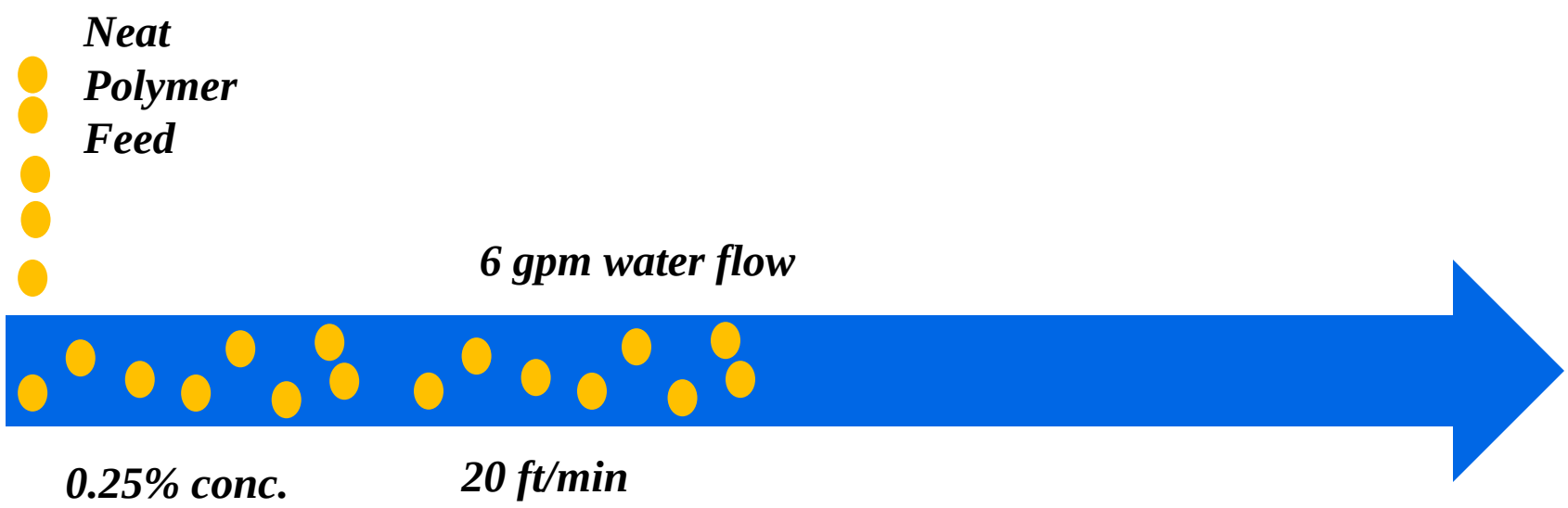

Fluctuating Water Pressure

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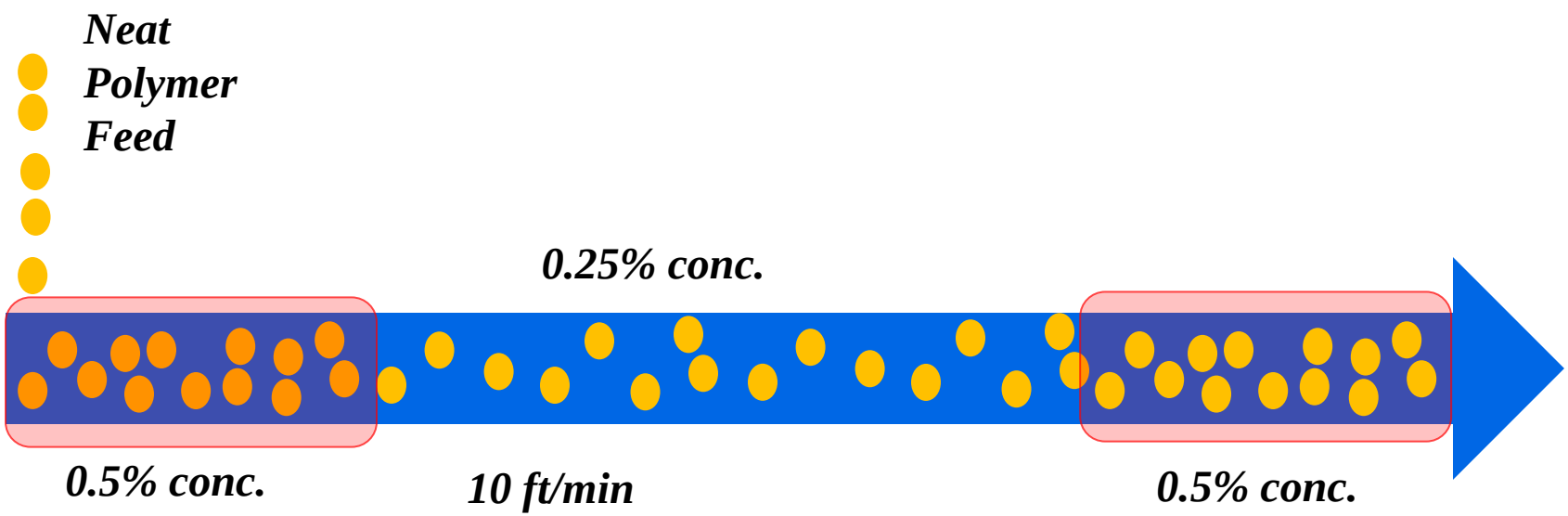


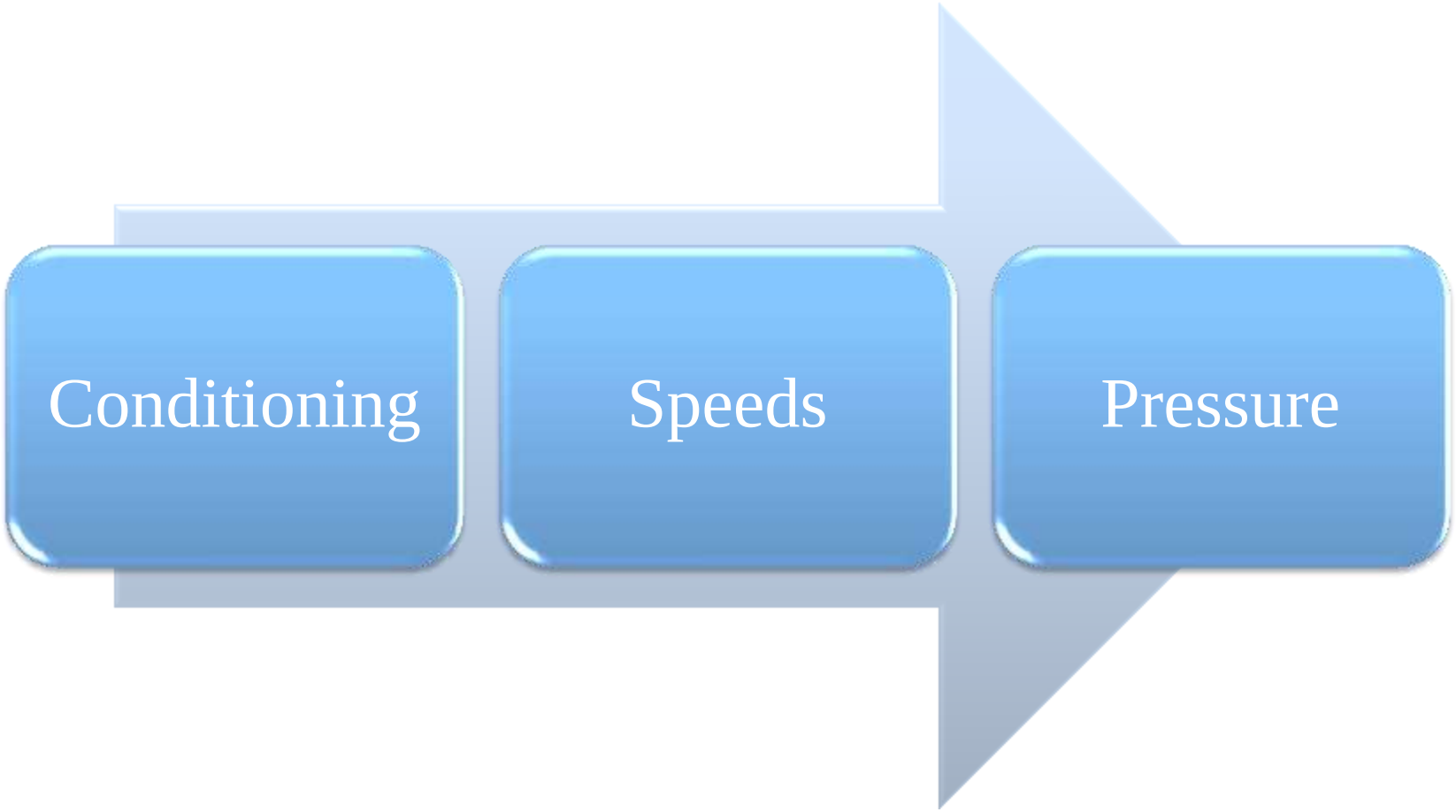
Consistency to the Press

- **Consistent Polymer Flow**
  - **Volume of Flow (gpm)**
  - **Concentration (%)**
- **Consistent Sludge Flow**
  - **Volume of Flow (gpm)**
  - **Consistent Make-Up**
    - **Percent Solids**
    - **Ratio of Blend or Type of Sludge**

Remove Variables

- **Consistency is Key**
  - **Blend Tank**
  - **Meter in outside sources**
  - **Mix settled sludges**
- **Easier to Find the Right Chemistry**
  - **A single polymer program is best**

Step by Step



Conditioning at Feedbox

Strong Floc with Clear Separation

Clean Initial Filtrate

Clean Filtrate at End of Gravity Zone

Belt Speed

- **Slow belts until cake is roughly 3/8” to 5/8”**
- **Time under pressure is important**

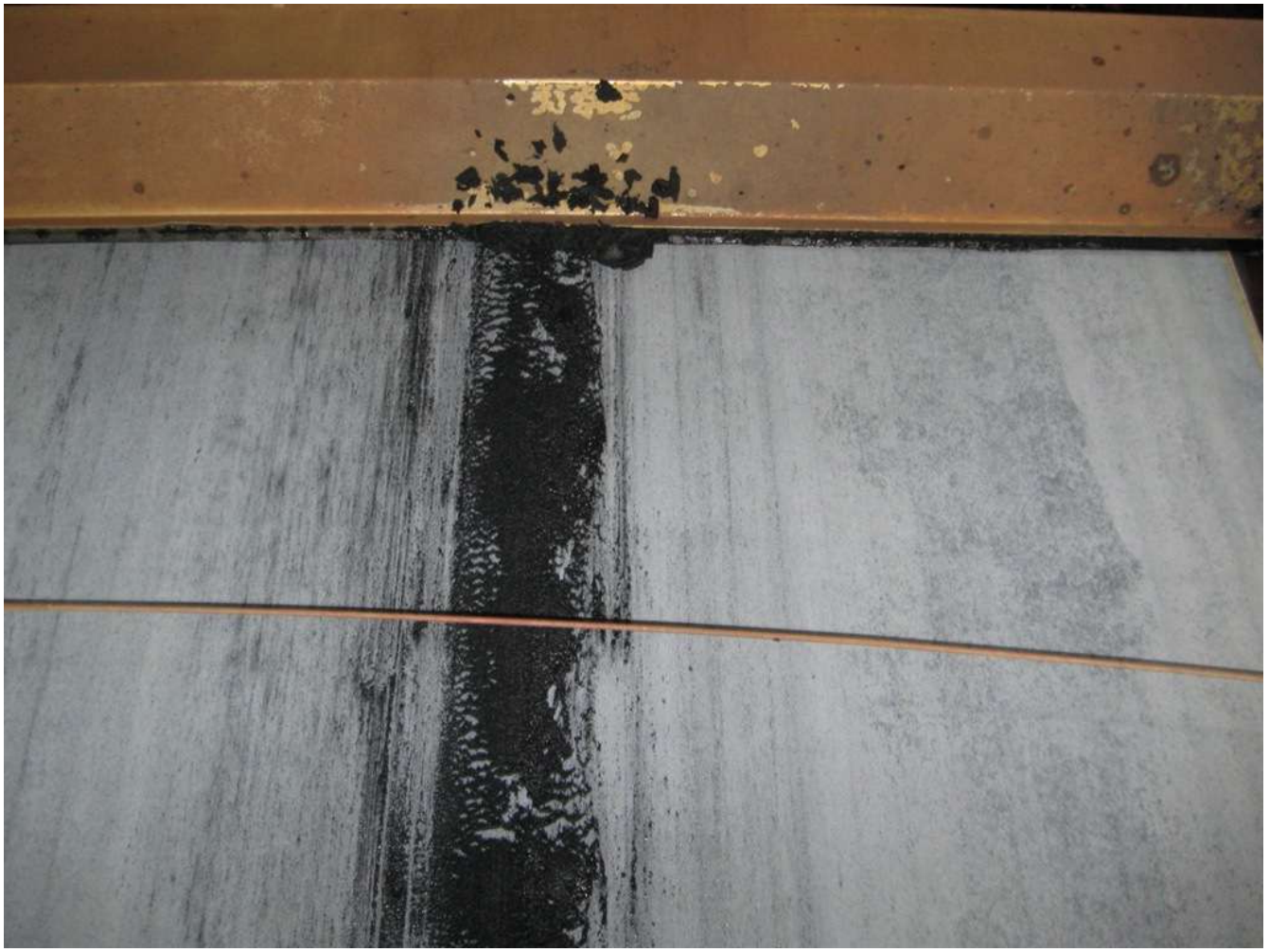
Belt Tensions

Specific Belt Press Notes

- **Full Belt Width**
- **Slower Belt Speeds**
- **Showers**
  - **Pressure**
  - **Nozzles**
  - **Angles**
- **Doctor Blades**
- **Worn Rollers, Slide Strips and Belts**

Poor Distribution

Shower with Plugged Nozzle



Post Shower Rollers

Thank You

questions?