Belt Press Optimization

OWEA

Biosolids Specialty Workshop

December 6, 2012

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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
- $6\text{gpm}/0.2 = 30\text{gpm}$ of discharge cake
- Or -- $6/30 = 20\%$
- $109\text{gpm} - 30\text{gpm} = 79\text{gpm from press}$
- 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 = \frac{(2T*W)}{D*\pi*W} * (R/360)
=2T/D\pi(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

Extrusion area

Material’ Dewatering Curve

Cake Pressure

Time under pressure
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

Cake Solids

Throughput

Polymer Dosage

Solids Capture
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

<table>
<thead>
<tr>
<th>Plant Information</th>
<th>VALUE</th>
<th>VALUE</th>
<th>VALUE</th>
<th>UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Plant Flow</td>
<td>1</td>
<td>3</td>
<td>10</td>
<td>MGD</td>
</tr>
<tr>
<td>Yearly Sludge</td>
<td>150</td>
<td>450</td>
<td>1500</td>
<td>Dry Tons per Year</td>
</tr>
<tr>
<td>Solids Throughput - Yearly</td>
<td>300000</td>
<td>900000</td>
<td>3000000</td>
<td>Dry Pounds per Year</td>
</tr>
<tr>
<td>Solids Throughput - Weekly</td>
<td>5769</td>
<td>17308</td>
<td>57692</td>
<td>Dry Pounds per Week</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Solids Capture</th>
<th>VALUE</th>
<th>VALUE</th>
<th>VALUE</th>
<th>UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recycled at 60% capture</td>
<td>120,000</td>
<td>360,000</td>
<td>1,200,000</td>
<td>lbs returned to head of plant (yr)</td>
</tr>
<tr>
<td>Recycled at 80% capture</td>
<td>60,000</td>
<td>180,000</td>
<td>600,000</td>
<td>lbs returned to head of plant (yr)</td>
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<tr>
<td>Recycled at 98% capture</td>
<td>6,000</td>
<td>18,000</td>
<td>60,000</td>
<td>lbs returned to head of plant (yr)</td>
</tr>
</tbody>
</table>
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

Treatment Process

Wasting Source

Dewatering Press
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
Shapowie – Aerobic Version
Shapowie – Aerobic Version
Shapowie – Aerobic Version
Shapowie – Anaerobic Style
Shapowie – Anaerobic Style
Shapowie – Anaerobic Style
Shapowie – Anaerobic Style
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

Neat Polymer Feed

3 gpm water flow

0.5% conc. 10 ft/min
Fluctuating Water Pressure

- Worse than you think

Neat Polymer Feed

6 gpm water flow

0.25% conc. 20 ft/min
Fluctuating Water Pressure

- Worse than you think

Neat Polymer Feed

0.5% conc. 10 ft/min 0.25% conc. 0.5% conc.
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  Speeds  Pressure
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?