Langley Separation & Process
Belt Press 101
Operational Training

Applying 40-Years of Experience and Process Knowledge
Belt Press 101

Belt Press Side View

- Sludge inlet
- Upper belt tensioning system
- Upper belt centering system
- Lower belt washing system
- Wedging roll
- Lower belt washing system
- Lower belt centering system
- Mixer
- Dewatered sludge outlet
Dewatering Fundamentals

- Process
- Mechanics
Process Components

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

Gravity

Wedge

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

Suspended Solids

Polymer

Floc
The primary mechanism is electrostatic attraction

Attractions between positive and negative charges

Analogous to magnetic attraction
Types of Water in a Biological Suspension

- Free water
- Cell walls
- Cohesive Water
- Intra cellular water
Conditioning Systems

- Venturi Effect
- Mechanical
- Combined
Conditioning

Belt Press 101

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

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

• Mechanical
Venturi Effect

- Turbulent Flow
- Laminar Flow
- Velocity Gradient
- Polymer

Belt Press 101

July 2018
BPF WR Sludge Mixer

Outlet

LOW ENERGY

HIGH ENERGY

Inlet

Gearbox

Agitator

Belt Press 101

July 2018
Venturi Effect
Process Schematic

Belt Filter Press

Mixing Valve

Dilution Water

Polymer Feed Pump

Sludge Feed Pump
Gravity Zone Function

• Distribution

• Drainage
  o Plows
  o Support grids
Belt Press Side View

- Lower belt tensioning system
- Upper belt washing system
- Wedging roll
- Lower belt washing system
- Lower belt centering system
- Upper belt centering system
- Sludge inlet
- Dewatered sludge outlet
- Mixer

July 2018
Belt Press Top View

Shower Cleaning
Handwheels

upper belt
tensioning system
mixer
sludge inlet

lower belt
tensioning system
Gravity Zone Nomenclature

- Belt
- Headbox
- Support Grid
- Plow (raised for cleaning)
- Plow (engaged)

Running Direction
Gravity Zone

Gravity

Low Pressure Zone Inlet

Sludge – Belt Contact Area

Gravity Zone Inlet

Gravity Area (ft²) = L x W
Thickening Plows Series
Arrangement

WATER
DRAINING
ZONE
• Provide a transitional pressure
  o >Atmospheric ~ 0.0
  o <1st high pressure roller- 1.5 PSI
Rolling Radial Wedge

1-2 in.

0.2 - 1.5 PSI

2.0 - 3.5 PSI
Perforated Roller
Area = \sum_{i=1}^{n} \left( 2 \times Ri \times \pi \times \left( \frac{\partial i}{360} \right) \times W \right)
Pressure

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

• **Area**
  - Expressed as PSIG
Calculating Area Pressure

\[ \partial \theta = <180^\circ \]

\[ \partial \theta = \frac{50 - 50}{5} = 10 \text{ PSI} \]
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 Forces

\[ \sum = S_1 + S_2 + S_3 \ldots \ldots S_{10} \]

\[ R_1 = 1205 \text{ mm} \]

\[ R_2 = R \times (1 + \text{Sludge thickness}) \]

Displacement

Felt

sludge

R_1

R_2
Optimum Pressure

Belt Press 101

July 2018
Excessive Pressure
Performance Relationships
Feed Solids Vs. Cake

ANAEROBIC DIGESTED SLUDGE

![Graph showing the relationship between Feed solids [%] and Cake dryness [%].](image-url)
Polymer Vs. Volatile Solids

Polyelectrolyte dosing [lbs/ton] vs. Volatile solids [% on TS]
Anaerobic

%Cake Solids vs %TSS
Municipal waste sludge (TSS = 4% ; VS= 65%)
Modular configuration

Belt Press 101

WR 5: working zones
WR 7
WR 9
WR 11
WR 13
WR 15

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

LS&P BFP Operational Training 101

July 2018
Polymer Vs Cake Solids

- Dependent upon:
  - Operator attention
  - Solids variance
  - Bandwidth
Factors Affecting Polymer Dosage

• Static
  o Feed suspended solids
  o Dissolved solids
  o Volatile solids concentration
  o Zeta potential

• Dynamic
  o Cascade effect
  o Detention
  o Mixing energy
  o Media impact
Throughput Terminology

Input

Output

Filtrate Loss
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!
- NEVER stand on side beams when operating
- NEVER place hands inside operating machine
- Verify Function of Tag Lines
- NEVER WORK ON ACTIVE MACHINE!
Questions or Comments

Contact Langley Separation and Process

1405 Pecan Circle
Canyon Lake, Texas 78133
Main: 512-662-9917
Cell: 817-269-8388
Email: tony@langleyseparationandprocess.com
Web: www.langleyseparation.com