BIOSOLIDS DEWATERING ALTERNATIVES

Operation, Performance, Optimization,

Advantages & Disadvantages

OWEA

Biosolids Specialty Workshop

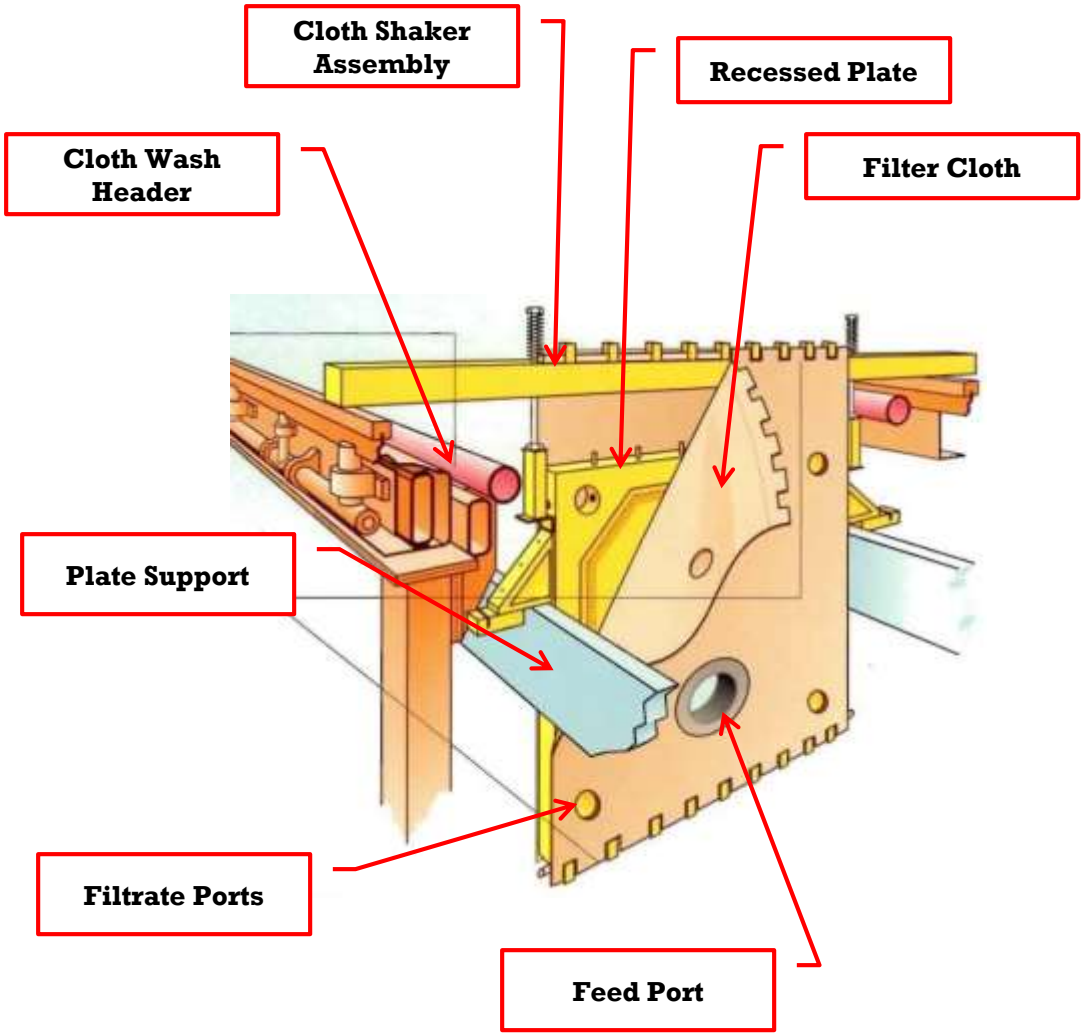
December 3, 2015

Dan Fronhofer, P.E.
BDP Industries

Dewatering Technologies

- Recessed Chamber Press – Plate & Frame
- Centrifuge
- Belt Press
- Screw Press / Rotary Press
- Mobile Dewatering
- Recent Trends

Recessed Chamber Press



Recessed Chamber Press

Recessed Chamber Press

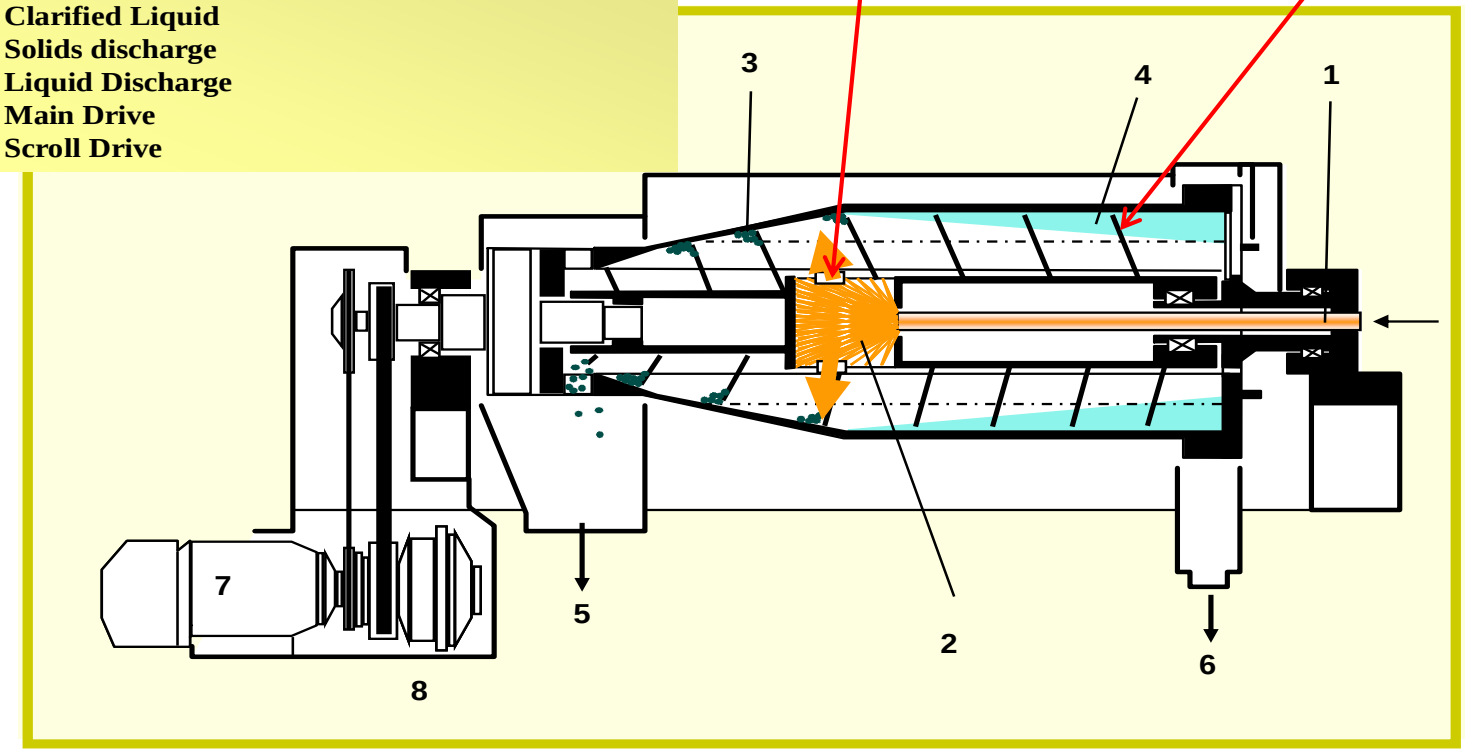
Recessed Chamber Press

Recessed Chamber Press

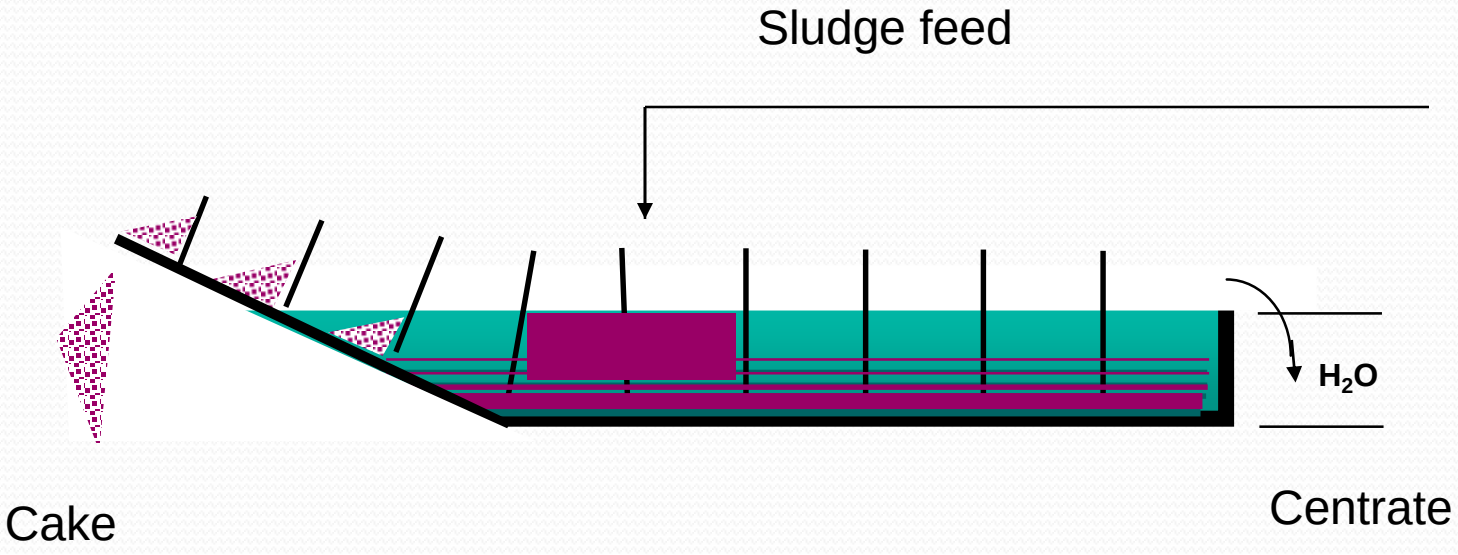
- Recent Improvements in Technology:
  - Increased Automation.
  - Control Interfaces.
  - Materials of Construction.

Solid Bowl Centrifuge

1) Feed
2) Feed Acceleration in Feed Zone
3) Solid Blanket
4) Clarified Liquid
5) Solids discharge
6) Liquid Discharge
7) Main Drive
8) Scroll Drive



Conveying Solids - Centrifuge



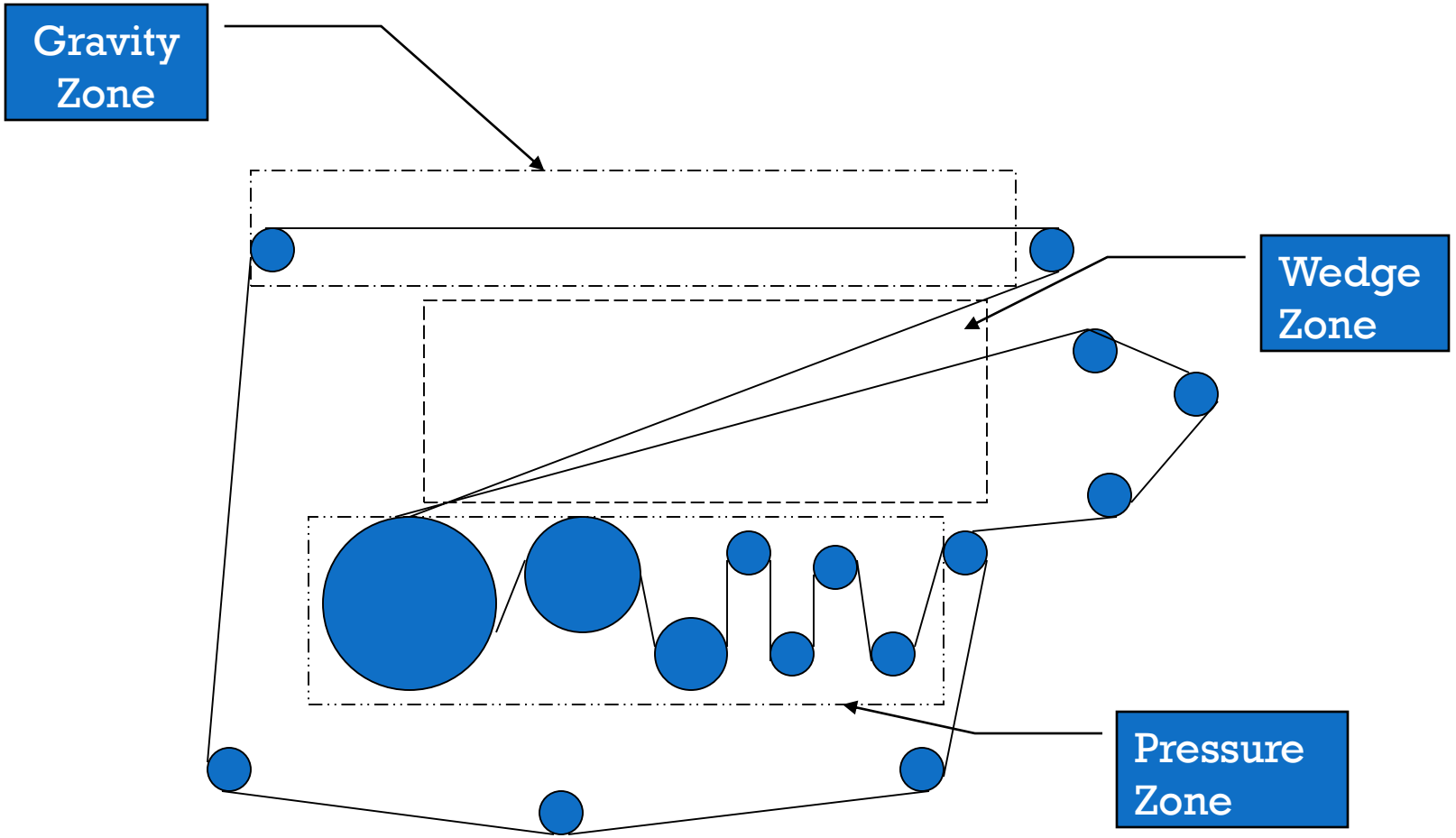
Centrifuge

30” Diameter Bowl

Centrifuge

- Recent Improvements in Technology:
  - Increased Motor Efficiencies.
  - Materials of Construction – decreased wear.
  - High Speed solid bowl, backdrive scroll on VFD.
  - Operational feedback loops – scroll amp draw.
  - Refined bowl shapes for particular materials.

Belt Press

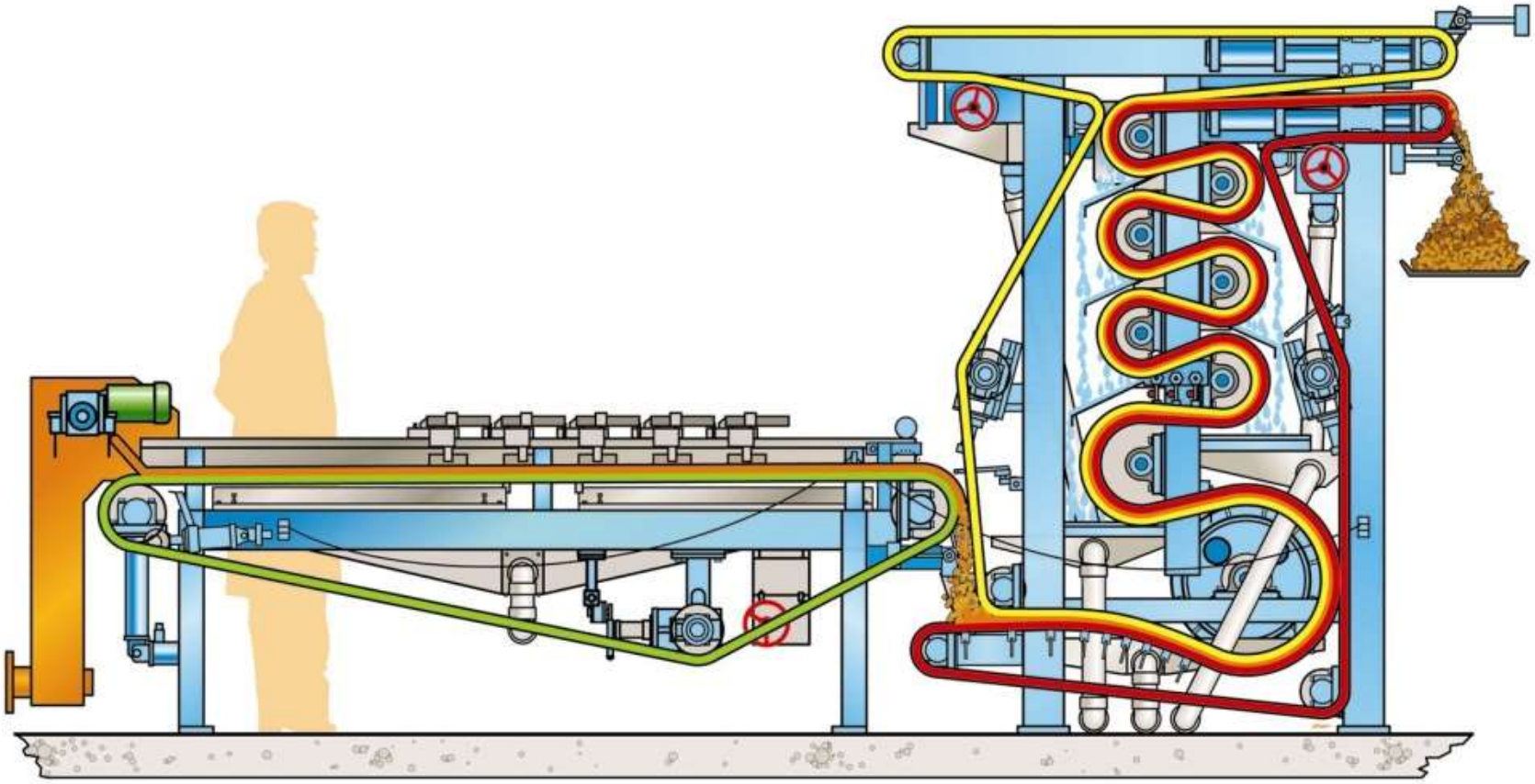


Belt Press

Belt Press

- Recent Improvements in Technology:
  - Improved Feed Distribution.
  - Independent Gravity Zone.
  - Dual Mode operation.
  - Curved Wedge Zone.
  - Improved Plow, more compression, exposing more filter cloth.
  - Vertical Compression Zone.
  - Floor Level Installation – no platforms.
  - Automation.
  - Odor control enclosures & piping.

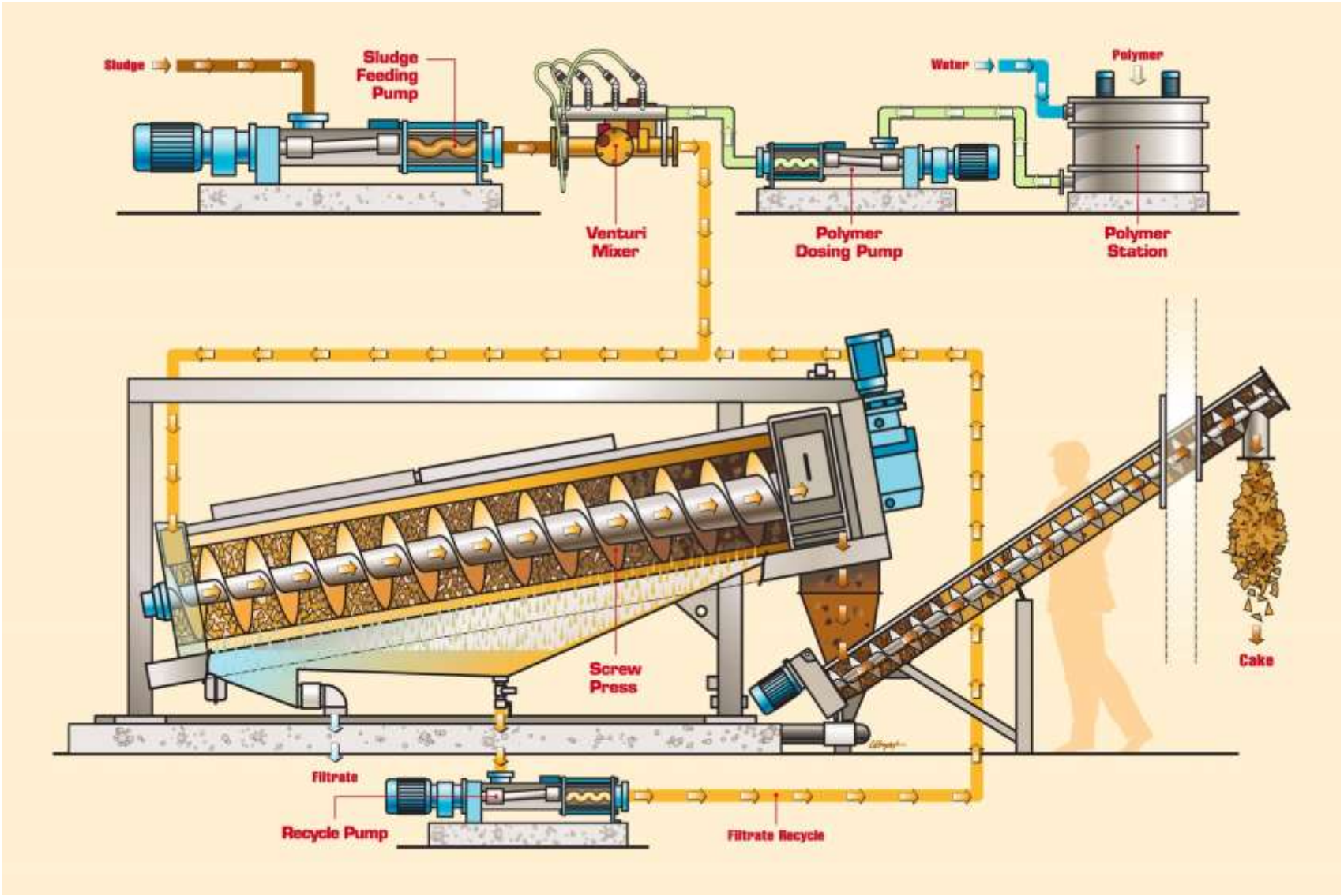
Belt Press



Screw Press

- Recent Improvements in Technology:
  - Brush / Flight Tip Design.
  - Pneumatic discharge cone.
  - Polymer mixing.
  - Independent pre-thickening.
  - Filtrate Recycle
  - Screen design.
  - Dual Mode operation.
  - Automation.

Screw Press


Sludge
Sludge Feeding Pump
Water
Polymer
Venturi Mixer
Polymer Dosing Pump
Polymer Station
Screw Press
Cake
Filtrate
Recycle Pump
Filtrate Recycle

Screw Press

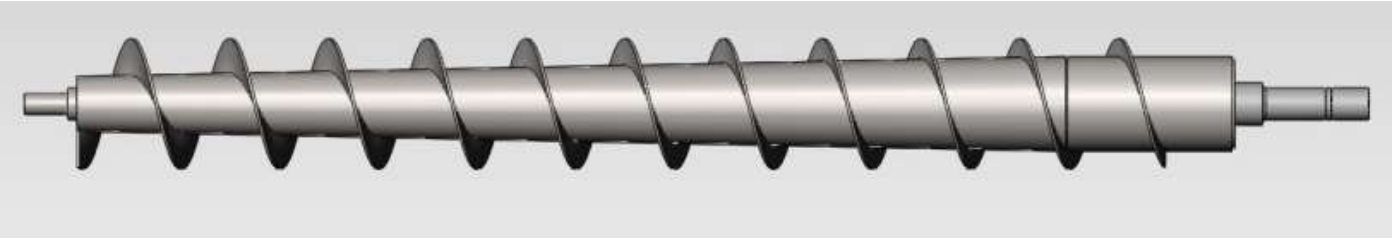
Screw Press

Screw Inlet

Discharge Cone

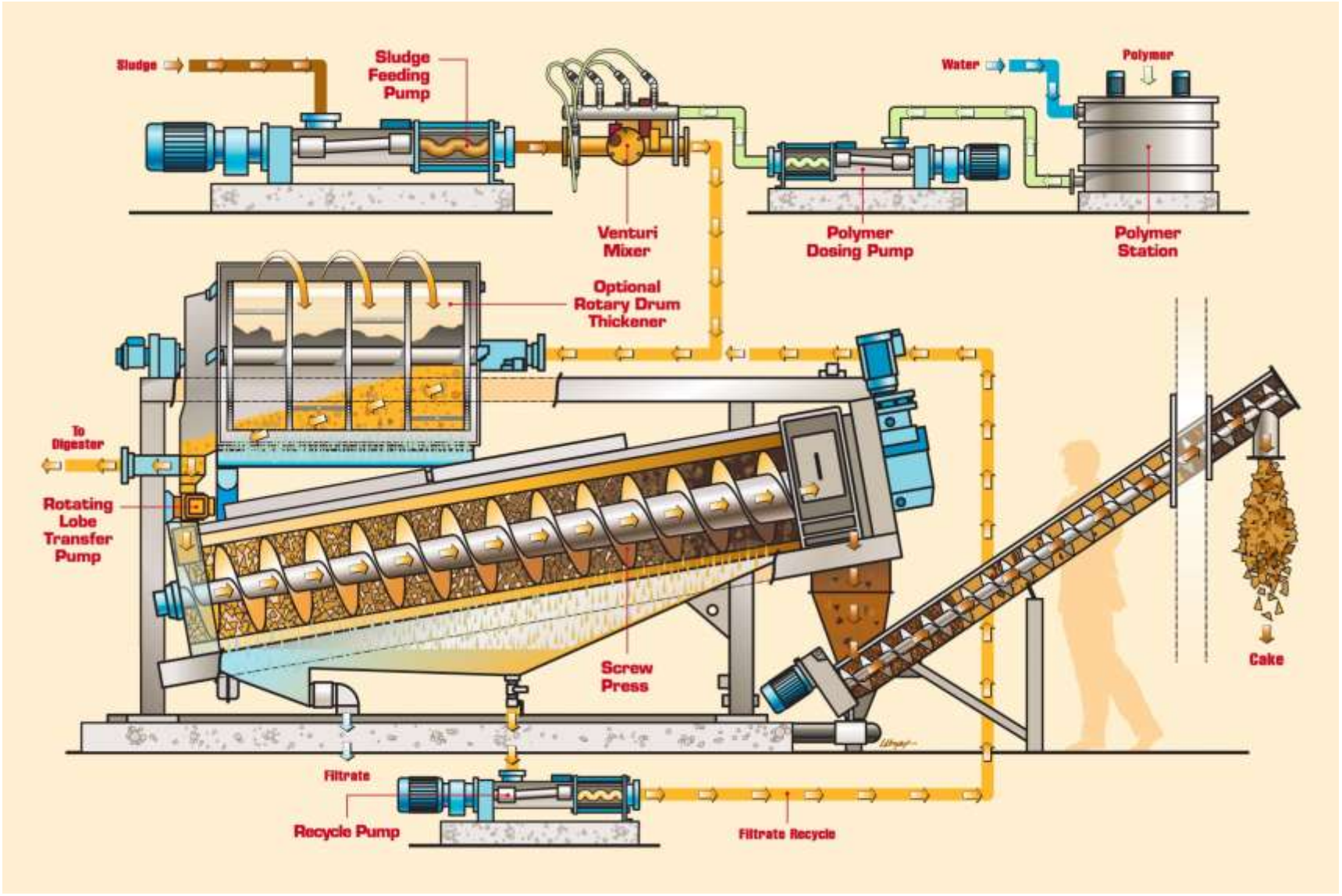
Screw Press

Tapered Shaft



Perforated Screen Basket

Screw Press


Sludge
Sludge Feeding Pump
Water
Polymer
Venturi Mixer
Polymer Dosing Pump
Polymer Station
Optional Rotary Drum Thickener
To Digester
Rotating Lobe Transfer Pump
Screw Press
Cake
Filtrate
Recycle Pump
Filtrate Recycle

Rotary Press

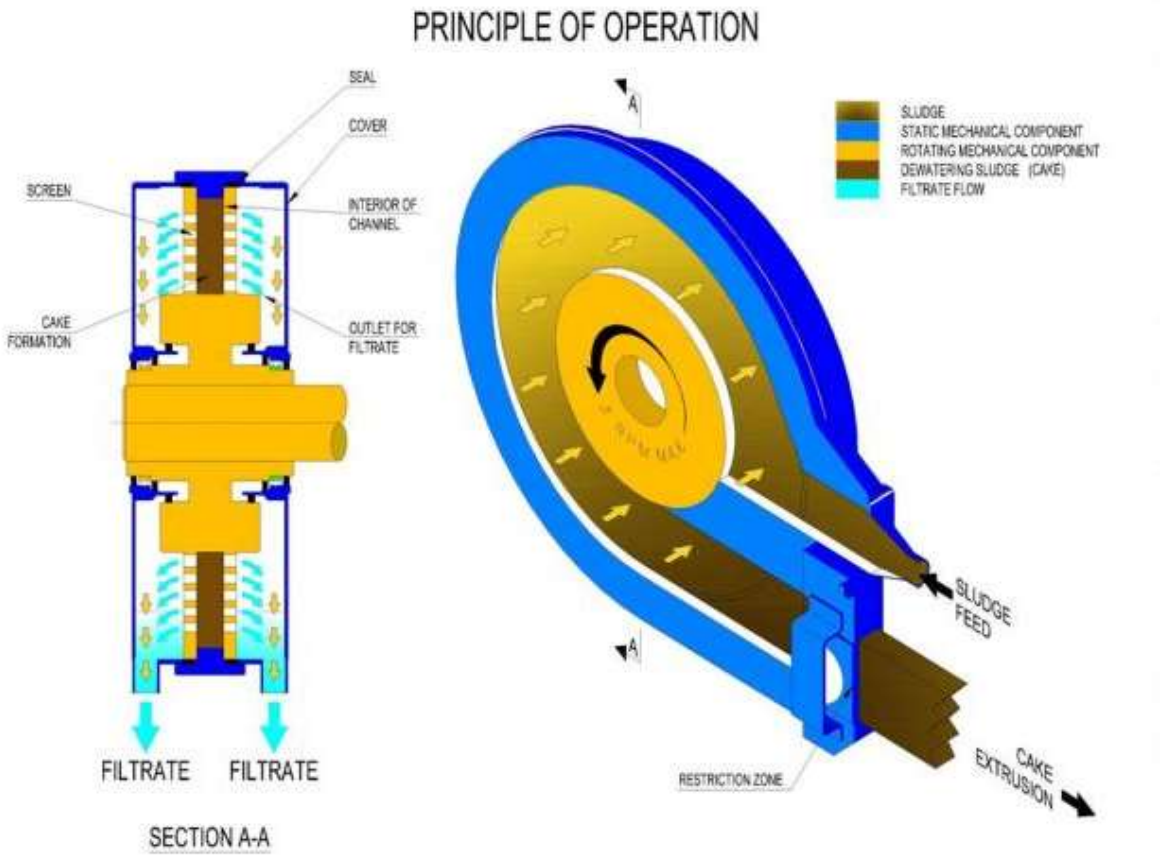


Image Source: Fournier Co. Product Brochure

Rotary Press

Front Royal, VA WWTP

Source: Treatment Plant Operators Magazine.

Recessed Chamber Press

Advantages:

- Highest filtration pressure: 100 to 225psi.
- Maintenance often done by plant personnel.
- Most repairs can be made in a couple of hours.
- Excellent solids capture when conditioned properly.
- Conditioning chemical costs can be lower.
- Amenable to daily operation. Must insure 2-5 hr cycle can be completed.
- Can process incompressible material.

Centrifuge

- Advantages:
  - Highest unit capacity per footprint, reduces number of units for large plants.
  - Containment of odor and process fluids.
  - Easier to keep operator area clean.
  - Less frequent preventative maintenance.
  - Maintains cake solids at higher than design loading, although solids capture suffers.
  - Smaller building.
  - Can process any material with S.G. differences.
  - Three Phase Separation is possible

Belt Press

- Advantages:
  - Low energy requirement.
  - Lowest polymer dosage.
  - Simple to Operate and Maintain.
  - Easy start up and shutdown amenable to intermittent operation, a few hours daily.
  - Maintenance can be done by plant personnel.
  - Process is observable allowing quick operator response to unstable conditions to avoid upsets.
  - Most repairs can be made in a couple of hours.
  - Operates will with incompressible material
  - Least expensive total Life Cycle Cost.
  - Higher Cake Solids than rotary Centrifuge for most sludge types.

Screw / Rotary Press

- Advantages:
  - Containment of process fluids and some odor.
  - Low energy consumption, similar to belt press.
  - Slow speed.
  - Low noise level.
  - Most maintenance can be handled by staff.
  - Facility easy to keep clean.
  - High torque possible with compressible material.
  - Easy start up and shutdown amenable to intermittent operation, a few hours daily.
  - Remote operation possible with correct ancillary equipment.

Recessed Chamber Press

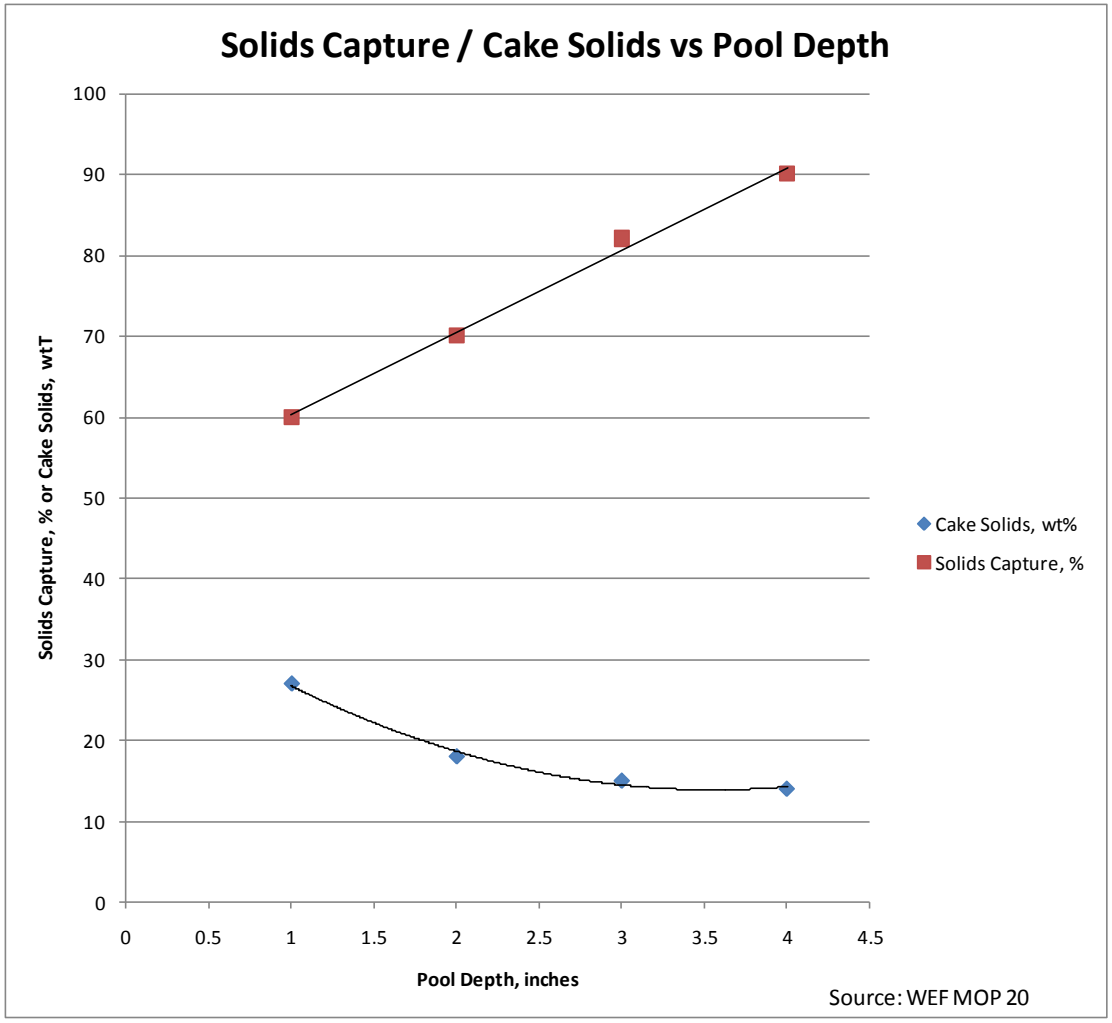
Disadvantages

- Batch process.
- Complicated Systems for: Feed pump, pre-coating, conditioning and metering of lime, ferric and fly ash. Variable Flow Rate effects dosage.
- Blow outs / Plate Breakage.
- Labor intensive for performing cake discharge and plate washing etc. or spend more $ for an automated system.
- Highest Operation & Maintenance Costs
- Large footprint for press and accessory systems: Feed pumps, conditioning tank, pre-coat make up, lime metering, pressure washer etc.
- Significant building structure to deal with size and weight of press and accessories.
- Frequent maintenance and cleaning.
- Can't observe process, At end of 2 hr cycle, cake discharge can be wet due to improper conditioning or blinded cloth.
- Expensive Discharge System: cake breakage and storage required due to batch operation.
- Odor containment difficult.

Centrifuge

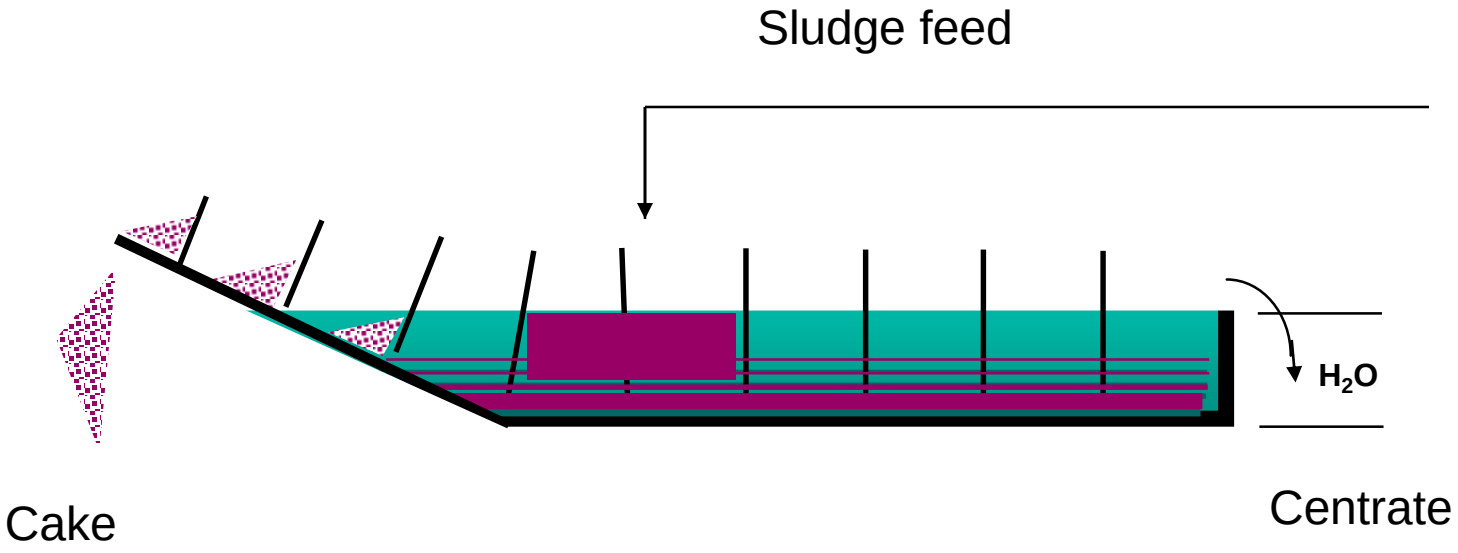
- Disadvantages:
  - Highest energy consumption, largest carbon footprint.
  - High usage of polymer.
  - Down time for repairs usually takes weeks/months.
  - Start-up and Shutdown take time and must be done carefully to avoid major damage to unit.
  - Operation needs to be continuous.
  - Instable sludge feed can make performance difficult to monitor and make proper adjustments.
  - Special structural requirements for equipment foundation.
  - Hearing protection for larger units.
  - Centrate often carries residual polymer.
  - Require many units to be economically viable.

Solids Capture: Centrifuge



Source: WEF MOP 20

Conveying Solids - Centrifuge



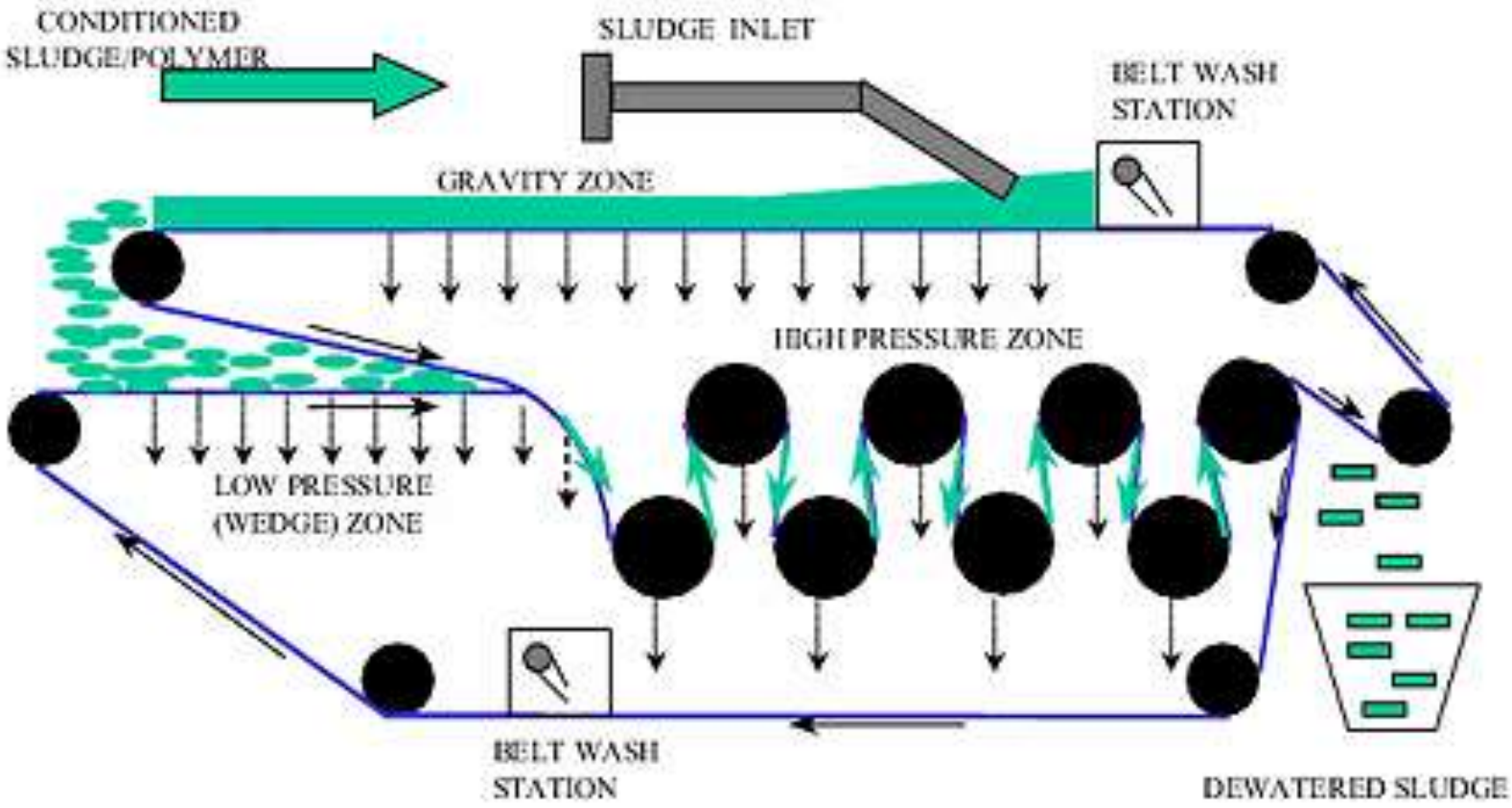
Belt Press

- Disadvantages:
  - Containment of odor and process fluids requires special enclosures.
  - Frequent maintenance and cleaning.
  - Height requirements.
  - Footprint requirements for large plants with multiple units.
  - Sump design is critical: Process upsets can require significant cleaning in certain layouts.

Belt Press

Totally Enclosed Belt Press

Belt Press Schematic

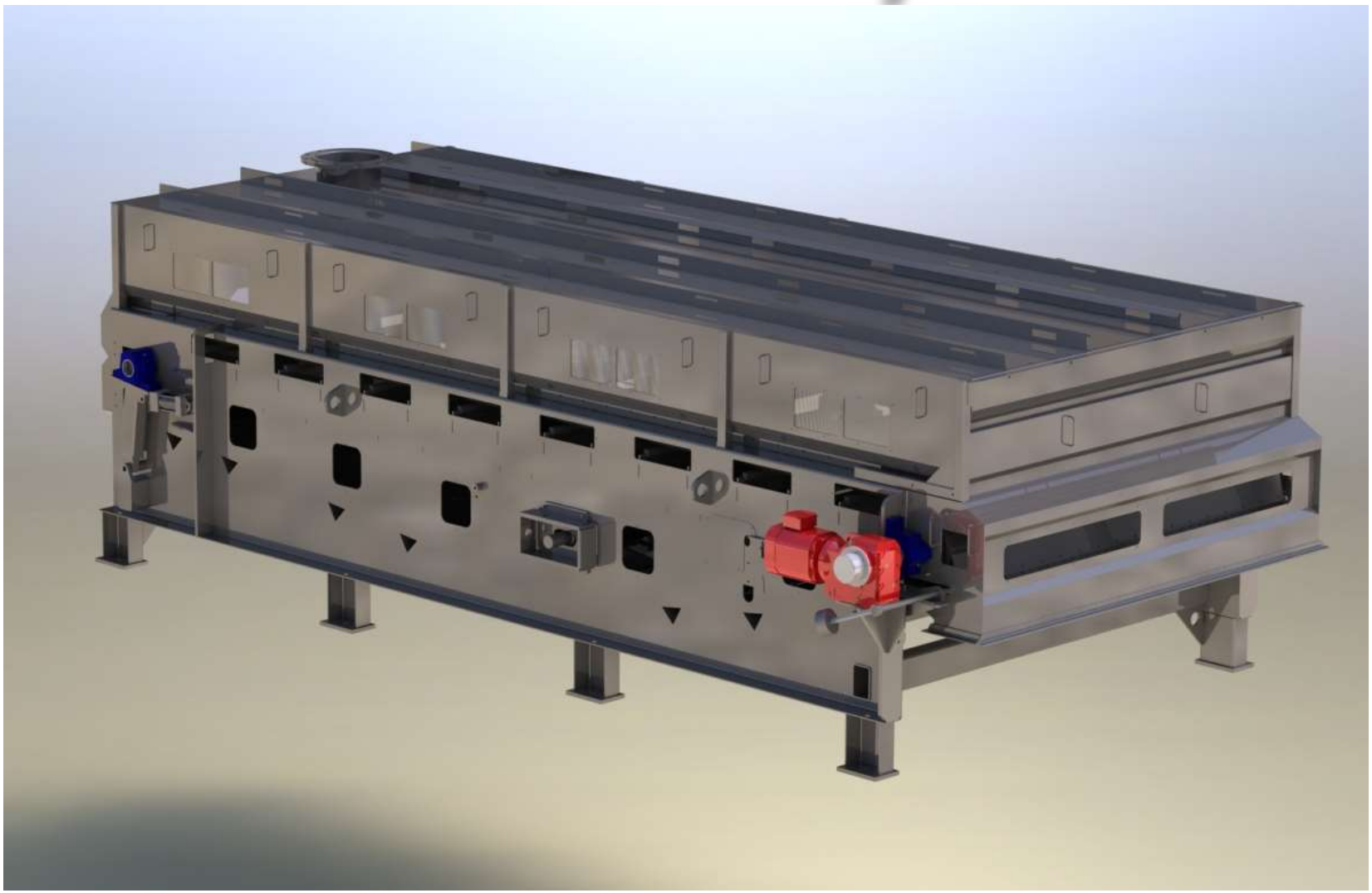


Belt Press

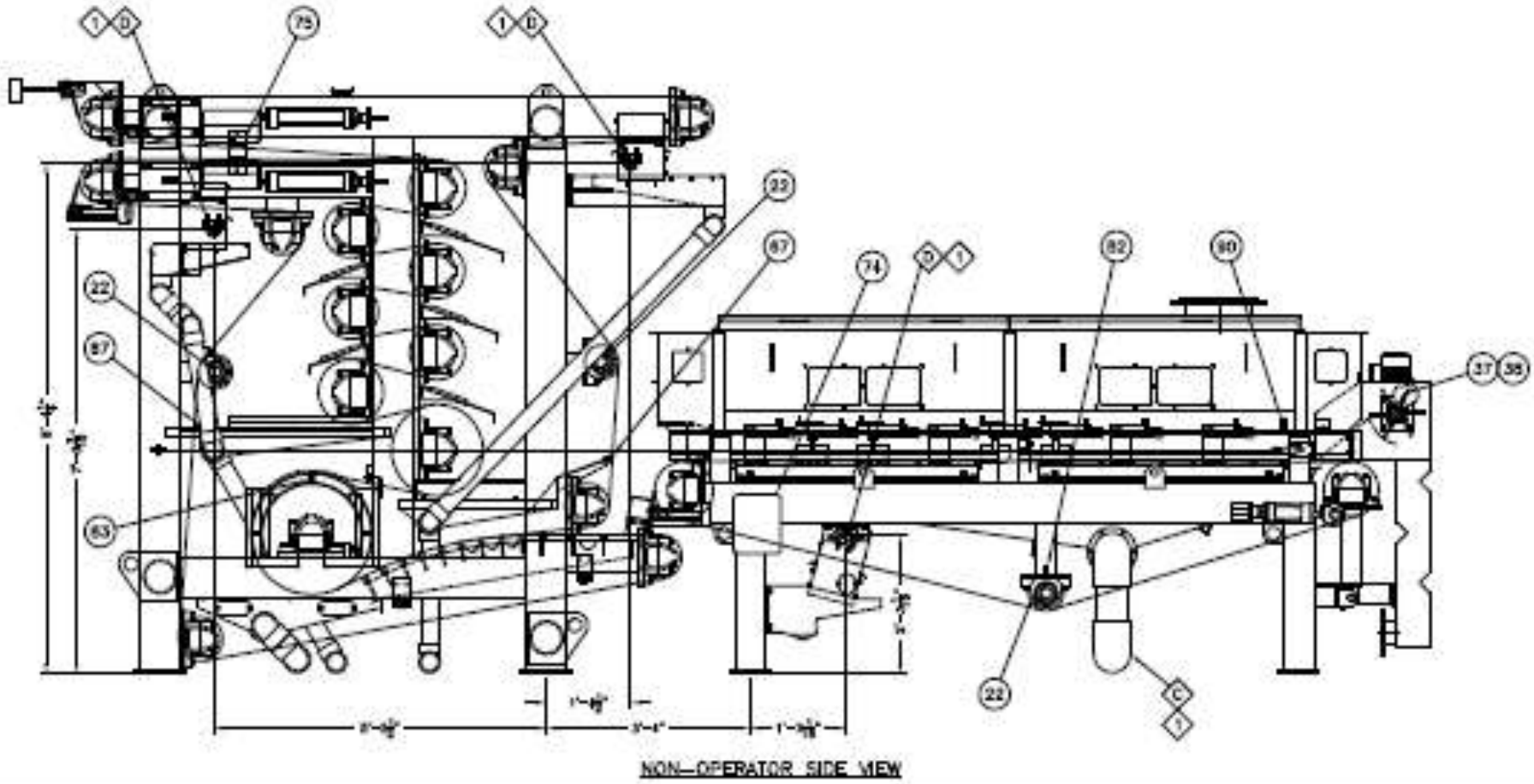
Odor Control Hoods for Belt Press

Belt Press – Enclosed Gravity Section

Enclosed Gravity Section



Belt Press



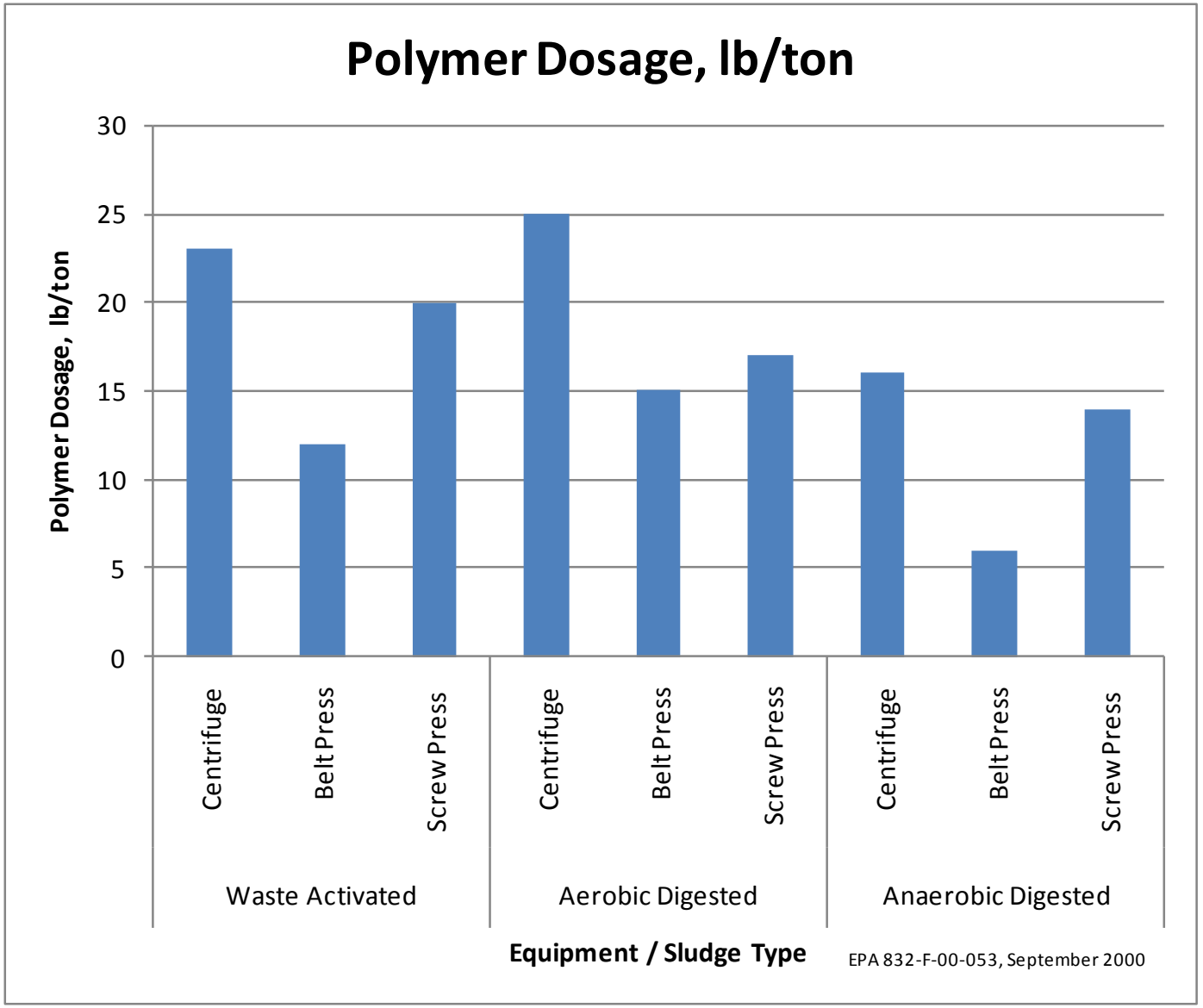
Odor Control Hoods for Belt Press

Screw / Rotary Fan Press

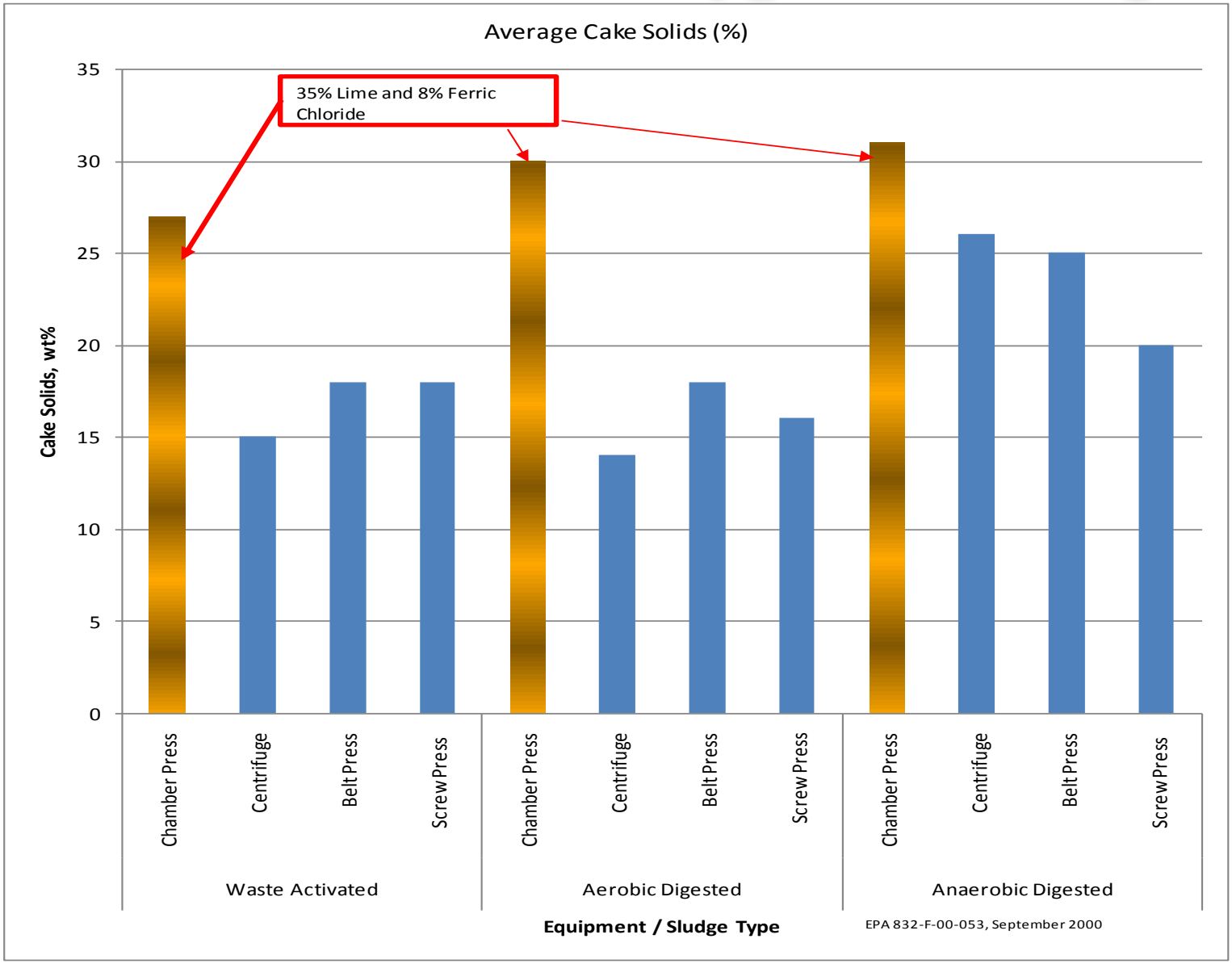
- Disadvantages
  - Lowest capacity per unit.
  - Lower solids capture than belt press.
  - Difficult to maintain solids loading/performance if influent concentration is variable.
  - Difficult to clean blinded filtration surface without shutting down and emptying.
  - Some designs need to remove screw for major maintenance.
  - Not meant to dewater incompressible solids.

Replacement brushes

Polymer Dosage vs. Type of Sludge



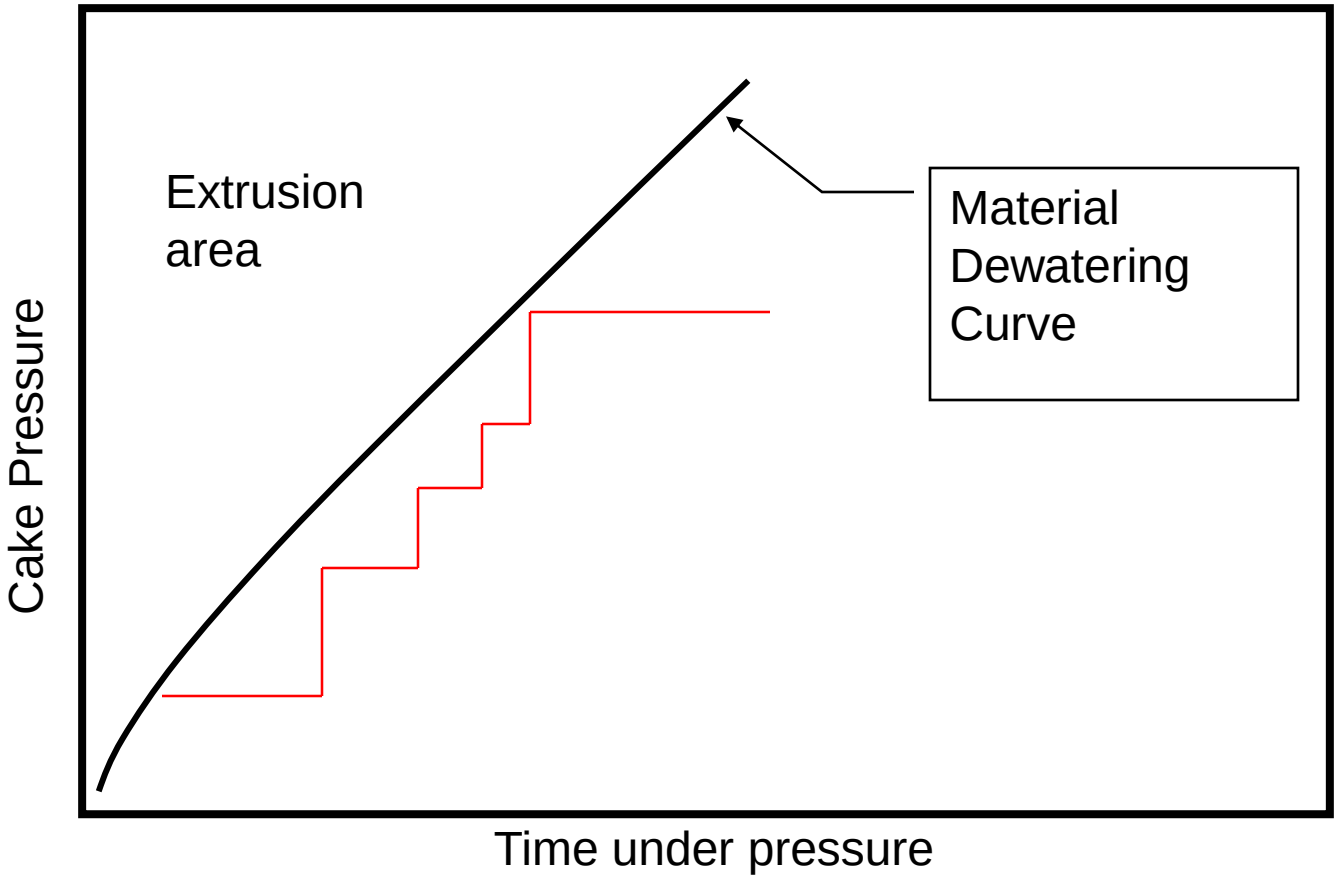
Cake Solids vs. Type of Sludge



Optimization Parameters

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

Pressure Section Design



Mobile Dewatering

Mobile Dewatering

Mobile Dewatering

Mobile Dewatering

- Drivers
  - Cost - $/gal or $/dry ton
  - Throughput – reduced time onsite
  - Performance – chemical dosage and cake dryness
  - Variable Conditions
- Capital Cost
- Maintenance Cost
- Full “Startup in a Day” – requires simplicity

Thank You

questions?