BIOSOLIDS DEWATERING ALTERNATIVES

Operation, Performance, Optimization, Advantages & Disadvantages

OWEA
Biosolids Specialty Workshop
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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
Recent Improvements in Technology:
- Increased Automation.
- Control Interfaces.
- Materials of Construction.
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

Sludge feed

Cake

Centrate

H₂O
Centrifuge

30” Diameter Bowl
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

Gravity Zone

Wedge Zone

Pressure Zone
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.
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

Screw Inlet

Discharge Cone
Screw Press

Tapered Shaft

Perforated Screen Basket
Screw Press
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 225 psi.
- 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.
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
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 well with incompressible material.
- Least expensive total Life Cycle Cost.
- Higher Cake Solids than rotary Centrifuge for most sludge types.
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.
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

Solids Capture / Cake Solids vs Pool Depth

Source: WEF MOP 20
Conveying Solids - Centrifuge

Sludge feed

Cake

Centrate

H₂O
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.
Totally Enclosed Belt Press
Belt Press Schematic

- Conditioned Sludge/Polymer
- Sludge Inlet
- Belt Wash Station
- Gravity Zone
- High Pressure Zone
- Low Pressure (Wedge) Zone
- Belt Wash Station
- Dehydrated Sludge
Odor Control Hoods for Belt Press
Belt Press – 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

Polymer Dosage, lb/ton

<table>
<thead>
<tr>
<th>Equipment / Sludge Type</th>
<th>Centrifuge</th>
<th>Belt Press</th>
<th>Screw Press</th>
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<tbody>
<tr>
<td>Waste Activated</td>
<td>25</td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td>Aerobic Digested</td>
<td>20</td>
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<td>15</td>
</tr>
<tr>
<td>Anaerobic Digested</td>
<td>15</td>
<td>5</td>
<td>15</td>
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EPA 832-F-00-053, September 2000
Average Cake Solids (%)

<table>
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<tr>
<th>Equipment / Sludge Type</th>
<th>Waste Activated</th>
<th>Aerobic Digested</th>
<th>Anaerobic Digested</th>
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<tbody>
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<td>Chamber Press</td>
<td>29.5</td>
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<td>31.0</td>
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<tr>
<td>Belt Press</td>
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</tr>
<tr>
<td>Screw Press</td>
<td>15.0</td>
<td>20.0</td>
<td>20.0</td>
</tr>
</tbody>
</table>

35% Lime and 8% Ferric Chloride
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

- Extrusion area
- Material Dewatering Curve

Time under pressure

Cake Pressure
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?