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Centrifuge Basics

Super Deep pond Centrifuges; Features & Benefits

Summary of Field Tests

Questions?
Centrifuge Basics

Sedimentation Pool
Sedimentation by Gravity

Clarification Area = Pool Surface:

\[ A = l \cdot w, \]

\( A: \) Surface, \( l: \) Length, \( w: \) Width

Driving Force \( f = \) Gravity = \( 1 \times g \)

Equivalent Clarification Area \( \Sigma = \) Driving Force \( f \times \) Surface \( A \)

\[ \Sigma = f \cdot A = l \cdot w \]
Clarifier principle

\[ V_c = \frac{g(p_s - p)d^2}{18m} \]

where

- \( V_c \) = Settling velocity of particle
- \( g \) = Acceleration due to gravity
- \( p_s \) = Density of particle
- \( p \) = Density of fluid
- \( d \) = Diameter of particle
- \( m \) = Dynamic viscosity of fluid
Decanter Basics
Flottweg SIMP-Drive®

- Lower installed HP and reduced energy consumption compared to hybrid, hydraulic or back drives
- Efficient independent control of the scroll and bowl

Steep cone design (increased separation volume)

Double Cone and Baffle Disk
Intensive compacting (drier solids) and longer clarification area (cleaner centrate).

Gentle product feed and acceleration

Deep Pond Design (Better efficiency and compacted solids, more sludge treatable at same diameter bowl)

Full flighted optimized scroll pitch with axial flow windows (improve centrate flow/quality).
Standard Scroll vs. Xellelor Scroll
Why Super Deep Pond Design?

• Super Deep pond design with the Xelletor models
  • Up to 20% less polymer consumption
  • Xtra dewatering performance; up to 2% higher total dry solids
  • Up to 15% more throughput

• SIMP-Drive®
  • Lower installed HP and reduced energy consumption compared to hybrid, hydraulic or back drives
  • Efficient independent control of the scroll and bowl

• RECUVANE®
  • Reduces energy consumption by 20% by using centrate energy

Scroll body = tubular space frame, immersed into the pond
Super-deep pond d/D = 0.45
Open feeding, no feeding chamber
18 deg. cone angle
Compression zone
SIMP-DRIVE®

State-of-the-art technology invented by Flottweg.

Flottweg experience no competitor can match!

Features of SIMP-DRIVE®

- **Automatic** and unattended operation via torque control
- **Highest efficiency** and reliability
- Small space requirement
- Independent scroll and bowl operation
- Standard of-the-shelf motors and frequency inverters
- Gear and belts are easily accessible from both sides.
- Belt guard for security and sound reduction purposes (facing side not shown)
Traditional design | New design
---|---
Centrate is discharged straight into the housing. | Centrate is redirected and tangentially discharged into the housing.
Rotational energy of the centrate is lost! | Rotational energy is recovered!
Recuvane® System...

... save up to 20%

additional **energy** by

using centrate energy with Recuvane®

<table>
<thead>
<tr>
<th>Traditional design</th>
<th>New design</th>
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Energy losses with continuous dewatering centrifuges are mainly due to the liquid and solid phase taking the rotary energy out of the decanter. The larger the distance to the rotary axle the more energy is lost.

Applied decanter design means reducing energy losses by bringing the overflow edge closer to the axle via smaller weir diameter.

State-of-the-art deep pond technology reduces specific energy consumption significantly:

- **Dewatering** as low as **0.2 kW/gal (0.27 hp/gal)**
  
  **(0.9 kWh/m³)**

- **Thickening** as low as **0.06 kW/gal (0.08 hp/gal)**
  
  **(0.25 kWh/m³)**
Wear options

Bowl liner

• Strips support the separation and conveying of solids
• Wear strips exchangeable in the field
• In case of bearing failure the strips will take the impact of the scroll and protect the bowl
Wear protection systems
Bowl wall

- Wear strips exchangeable on the field
- Strips support the separation and conveying of solids
- In case of bearing failure the strips will take the impact of the scroll and protect the bowl
Wear Protection
Scroll flights – WCS

- Standard: Flame sprayed tungsten carbide
- Minimum 15,000 hrs life guarantee. Up to 20,000 hrs

- Option: Tungsten carbide tiles
- Up to 25,000hrs life guarantee on wear (not on loss)
Wear Protection
Solids discharge

- Standard: Hard metal (chilled cast iron or ceramic) wear bushings
- Standard: Scraper strips
Centrifuge Basics

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Summary of Field Tests

Questions?
Xelletor Field Tests

<table>
<thead>
<tr>
<th>Year</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>July 2015 – Jan. 2016</td>
<td>Prototype tests X4E in a sewage plant close to our headquarters, and USA</td>
</tr>
<tr>
<td>2016</td>
<td>14 Tests in Austria, Germany and Switzerland</td>
</tr>
<tr>
<td>2017</td>
<td>26 Tests in Germany and Italy</td>
</tr>
<tr>
<td>2019</td>
<td>Over 180 tests in USA, Germany, Poland, UK, Belgium, Spain, Switzerland, Italy</td>
</tr>
</tbody>
</table>
Summary Test Results
Digested Sludge

Flottweg Decanter C4E
- with standard rotor
- with Xellelor rotor

Cake Dryness (%) w/w vs. Spec. Torque (Nmh/kgDS)
Summary Test Results
Digested THP Sludge

Flottweg Xellelor X4E
Flow rate: 10 – 15 m³/h
Summary Test Results
Waste Activated Sludge Dewatering

Cake Dryness (% w/w) vs. Spec. Torque (Nmh/kgDS)

Flottweg Xellelor X4E
Conclusions:

Dewatering efficiency:

- Apparently, Xelletor converts torque better into compression / cake dryness
- This effect becomes more evident with the higher degree of digestion: THP ≥ anaerobic digestion ≥ aerobic digestion
- The potential for higher cake dryness is driven by the sludge characteristics, and the limit for dewatering driven by the physical natures of the sludge and if it is suitable for Xelletor

Polymer demand:

- Xelletor generates less friction/shear stress on the flocs, thus the polymer demand is lower
- This was also observed in cases where there was no improvement in cake dryness
Thanks to our Test Team!
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