IMPROVING SCROLL DECANTER CENTRIFUGE EFFICIENCY BY PREFLOCCULATION OF FEED

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Premise of preflocculation step

- Particles 2 µm and less in size cannot be collected without the addition of flocculating agents.
- SDC can separate solids whose settling rates are > 1.5*10^{-4} cm/s.
- Therefore flocculating agents have to be used to separate FFT solids.

Energy of separation = $E_{floc} + \sum E_i$
Preflocculation using inline static mixers

- Controlled flocculation time
- Steady hydrodynamic flow
- Pipe: schedule 40, 1”
- Void fraction ~0.9 (KMS, Koflo)

KMS

Koflo 275
Flow diagram of separation process
Separation process test units
Scroll decanter centrifuge separation

Pool zone → Beach

Feed

Centrate

Bowl

Scroll

Cake

Motors (gears Belts)

http://www.sgconsulting.co.za/images/Selecting%20the%20right%20centrifuge.pdf
## Power consumption breakdown

<table>
<thead>
<tr>
<th>Process</th>
<th>Relationship</th>
<th>G-force</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feed acceleration</td>
<td>$P_{FA} = Q \rho_f x_f \omega^2 \left[ r_c^2 + r_L^2 \left( 1 - \frac{1}{x_f} \right) \right]$</td>
<td>directly proportional</td>
</tr>
<tr>
<td>Rotating assembly</td>
<td>$P_{RA} = \frac{\omega^2}{t} \sum I_i$</td>
<td>directly proportional</td>
</tr>
<tr>
<td>Cake transport</td>
<td>$P_T = M_c \omega^2 r C_f v$</td>
<td>directly proportional</td>
</tr>
<tr>
<td>Windage</td>
<td>$P_W = k_S \mu_A^{0.2} \rho_A^{0.8} \omega^3 D^{4.5}$</td>
<td>Proportional to power of 1.5</td>
</tr>
<tr>
<td>Friction power loss</td>
<td>Constant % of transmitted</td>
<td>directly proportional</td>
</tr>
</tbody>
</table>
Bowl motor power
feed spg = 1.17, Q = 18.3 L/min
Motor power dependence on G-force feed spg = 1.17, Q = 18.3 L/min
Preflocculation effect on centrifuge performance
feed SPG = 1.16, $\bar{\Omega} = 18.2$

![Graph showing fines capture and centrate solids percentage against G-force (g).](image-url)
Mixing energy input effect on separation performance @ 536G

![Graph with data points and lines indicating the relationship between Fines capture % (w/w) and Concentration solids % (w/w) for different values of Q (L/min).]

- **Fines capture % (w/w)**
  - Preconditioning with/without 12 KM S, 24 KM S, and 12 koflo.

- **Concentration solids % (w/w)**
  - Preconditioning with/without 12 KM S, 24 KM S, and 12 koflo.

- **Q (L/min)**
  - Values range from 18 to 28.

The graph shows the effect of mixing energy input on the separation performance under different preconditions and flow rates.
Separation performance for increased mixing Q = 18.1L/min, spg=1.17 @ 536G
Energy input under turbulent flow of the preflocculation step

![Graph showing energy input under turbulent flow of preflocculation step](image_url)
Tradeoffs

- Lower G-force results in more moist cake

<table>
<thead>
<tr>
<th>G-force</th>
<th>438</th>
<th>536</th>
<th>1463</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solids % (w/w)</td>
<td>49</td>
<td>51</td>
<td>54</td>
</tr>
</tbody>
</table>

- Power consumption of the inline static mixers; 8 watts for 12 element mixers
Sound level of two SDCs at varying G-force

- GEA CD205
- Alfa Laval Lynx 40

Graph showing sound level against \( \sqrt{G} \) for different durations (2 h and 8 h).
Conclusions

- Power consumption by the SDC is directly proportional to the G-force.
- Most of the power is consumed to maintain the rotation speed of the SDC machine.
- Preflocculation enables separation at low G-force.
- Above all, preflocculation increases the throughput capacity of the SDC.
- There is a mixing energy range for the flocculation that results in efficient separation.
- The sound level of SDC is linearly related to the rotation speed.
Acknowledgements

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