Investigating the Potential of HydroFloat™ Coarse Particle Flotation Techniques on Copper Sulphide Ores

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Peter Mehrfert - ALS Metallurgy

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Presentation Outline

- Coarse particle losses in conventional flotation
- Eriez HydroFloat™ Separator – description
- Comparisons of metallurgical performance - copper ores
  - Denver lab cell Vs. HydroFloat™ – recovery by size
- Mineralogical assessments of coarse fractions
- Potential circuit configuration
Coarse Particle Losses – Conventional Flotation

Recovery typically decreases significantly above 200μm

- Poor liberation in coarse fractions, not much sulphide mineral surface for bubble attachment
- Mass of coarse grains requires a larger bubble for buoyancy
- Agitated tank not ideal to maintain attachment of coarse particles to bubbles – high mixing energy required for suspension, fine particle attachment
- Coarse particles can drop out of froth phase easily
Coarse Particle Losses – Conventional Flotation

Mill process is designed around these limitations

- Grind to $P_{80}$ values finer than 200μm

- Long retention times to accommodate low success rate of coarse particle recovery sequence – attach / pulp transport / froth transport
HydroFloat™ Separator - Operation

- Feed slurry is presented to the teeter bed zone.
- Teeter water added to fluidize bed and provide rise rate.
- Air/frother introduced with teeter water.
- Coarse mineralized particles recovered from teeter bed.
- Teeter bed level controlled by a pressure sensor.
- Underflow density approximately 65% solids.
- Concentrate is light density, contains feed grade fines.
HydroFloat™ Separator - Testing

Feed preparation – remove fines (<150μm)

- Rise rate will recover fine feed grade material by hindered settling, dilutes concentrate
- High contents of fine material in the feed will compromise teeter bed control, extend time required to reach steady state
- Condition coarse feed pulp with collector prior to testing

Dynamic test, requires continuous feed

- Feed rate to lab cell 1 – 2 kg/minute, may require 8 minutes to reach steady state, another 5 minutes for sampling ~ approximately 20 kg required to test one condition
Three different feeds were evaluated:

<table>
<thead>
<tr>
<th>Sample</th>
<th>Type</th>
<th>Sulphide Minerals</th>
<th>Head Assay Cu %</th>
<th>Feed F80 (μm)</th>
<th>Conventional Water (m³/hr/m²)</th>
<th>HydroFloat Water (m³/hr/m²)</th>
<th>HF Teeter Water (m³/hr/m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Fresh Feed</td>
<td>Chalcopyrite, Pyrite</td>
<td>0.30</td>
<td>547</td>
<td>675</td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>2</td>
<td>Rougher Tails</td>
<td>Chalcopyrite, Bornite, Pyrite</td>
<td>0.04</td>
<td>447</td>
<td>546</td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>3</td>
<td>Cyclone U/F</td>
<td>Chalcopyrite, Pyrite</td>
<td>0.23</td>
<td>383</td>
<td>412</td>
<td></td>
<td>16</td>
</tr>
</tbody>
</table>

Difference in feed sizing is due to inclusion of <150μm material in Denver test feeds.
An additional 41 percent of the copper contained in the >212μm fractions was recovered in the HydroFloat™ test compared to the conventional test.
An additional 18 percent of the copper contained in the >212μm fractions was recovered in the HydroFloat™ test compared to the conventional test.
An additional 24 percent of the copper contained in the >212μm fractions was recovered in the HydroFloat™ test compared to the conventional test.
Test Product Mineralogy – Surface Exposure

Mineralogical assessments using QEMSCAN

- Assessed concentrate and tails from HydroFloat™ tests, coarse fractions
- Exposed copper sulphide mineral as percent of grain perimeter - two dimensional assessment

- Grouped copper sulphide observations into exposure categories, more resolution at low exposure levels (100-50, 50-25, 25-15, 15-10, 10-5, 5-0 %)
HydroFloat Test Products – Surface Exposure

Re-calculated feed – Copper sulphide surface exposure

Limited portion of the grains have copper sulphide exposures >15%
~approximately 21% for Sample 1, 24% for Sample 3
Hydrofloat Test Products – Surface Exposure

Recovery relative to copper sulphide surface exposure

Consistent trends in recoveries relative to copper sulphide exposure in each size class.
Potential Circuit Arrangement

Split Circuit – coarse primary grind, separate rougher recovery of coarse and fine portions

- Approximately equal mass split to coarse and fine circuits
- Total tailings 42% solids
Conclusions

- Considerable improvements in copper recovery can be achieved in coarse fractions using a HydroFloat™ separator compared to conventional flotation.
- Particles as coarse as 600μm can be well recovered with copper sulphide exposure levels as low as 15%, as measured in two dimensions.
- Recovery relationships to copper sulphide exposure are somewhat consistent in each size class.
- Inclusion of a HydroFloat™ separator in a split circuit flow sheet can offer considerable secondary grinding energy savings.
Acknowledgments

ALS Metallurgy - Kamloops

Eriez Flotation Division
Questions?