McArthur River Heavy Medium Plant

Presented by Jim Wallace
• Part of Glencore Zinc
• MRM in operation since 1995
• Originally U/G mine extracting 1.8Mt/a lead-zinc ore (Phase 1)
• Converted to open cut mine in 2007 2.4Mt/a ROM ore (Phase 2)
• 2014 Phase 3 upgrade to 5.5Mt/a ROM ore
MRM Ore

• Ore in bands separated by barren interbeds of silica
• Amenable to gravity separation to reject interbed silica
• 8 separate ore bodies. 2-8 regarded as economic
• Treated as composites 2-2/3, 3-4, 5, 6-8
• 6-8 lower grade than 2-5 and mainly untreated prior to HMP
• Future mine plan required processing 6-8 ores
Reason for HMP

• Mine head grades forecast to drop
• Need to increase ROM capacity to maintain cons production
• On site power station operating at max capacity
• Pre-concentration the only way to increase ROM capacity in short term prior to power station upgrade
• Heavy medium cyclone plant most efficient option at mill feed size ($P_{80} = 10-15\text{mm}$)
Design Criteria

- Target Pb and Zn recovery of 95% (reject grade < flot tail grade)
- Plant Feed P$_{80}$ of 10-15mm for sufficient liberation
- 20% of HMP feed < 1.2mm
- Benefit of DMS on 2-23 ores is marginal.
- Decided to build an HMP to treat primarily 6-8 ores

<table>
<thead>
<tr>
<th>Ore</th>
<th>Zn Recovery to Product</th>
<th>% of Cyclone Feed to Rejects</th>
<th>% of HMP Feed to Rejects</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-23</td>
<td>95%</td>
<td>18.5%</td>
<td>14.8%</td>
</tr>
<tr>
<td>3-5</td>
<td>95%</td>
<td>24.0%</td>
<td>19.2%</td>
</tr>
<tr>
<td>6-8</td>
<td>95%</td>
<td>33.0%</td>
<td>26.4%</td>
</tr>
</tbody>
</table>
Feed Liberation

- Requirement for high recovery
  - $P_{80}$ 10-15mm for sufficient liberation
  - Minimal near gravity material
MRM HMP

• 1.8Mt/a Pre-concentration HMP first part of Phase 3 Project
• Designed to treat low grade 5, 6-8 ore body composites
• Commissioned Aug 2012
Plant Design Basis

- Based on Mt Isa Flowsheet
- Existing Australian base metal HMC plants gravity fed
- 250 t/h (dry) feed rate @85% availability
- MRM plant designed using modern coal HMC plant principles
  - Pump fed HM Cyclone
  - Wing tank
  - Multislope Screens
  - Ceramic tile base mounted sumps
Flowsheet
Key Equipment – HM Cyclones

- 2 x 610mm high capacity HM Cyclones
- Spigot Capacity Constrained
- ‘Breakaway’ size probably not significant factor to clean separation
Key Equipment - Screens

- 2.4x6.1m multislope screens for Deslime, Product and Reject Screens
Key Equipment – Magnetic Separators

• 2 off 1.2m dia x 3.0m long counter-rotating magnetic separators

• Best to size conservatively due to cost of FeSi
Key Equipment - Densifiers

- 2 x 150mm Densifier
- Cyclones
Key Equipment - Sumps

- Std Coal Design
- Foot Mounted
- Ceramic Tiled
- Sumps
Key Equipment – Wing Tank

• HM Cyclone
  Feed Wing Tank
Plant Ramp Up & Debottlenecking

• Nominal design and recovery reached quickly
• Feed rates pushed up to try maximise plant capacity
• 2nd feeder, feed conveyor drive upgrade, large dewatering screens and slimes thickener underflow line upgrade to increase plant capacity >500tph
Actual vs Design Key Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Std Base Metal Design</th>
<th>Actual MRM</th>
</tr>
</thead>
<tbody>
<tr>
<td>De-slime Screen</td>
<td>6m³/h solids/m²</td>
<td>12m³/h solids/m²</td>
</tr>
<tr>
<td>DM Cyclone Head</td>
<td>14-21D</td>
<td>7.0 - 9.5D</td>
</tr>
<tr>
<td>Medium : Solids Volume Ratio</td>
<td>8:1</td>
<td>3-4:1</td>
</tr>
</tbody>
</table>
Quaterly Average Plant Feed Rate

![Bar chart showing quarterly average plant feed rate from Q312 to Q315. The values range from around 200 t/h (dry) in Q312 to approximately 550 t/h (dry) in Q315.]
Quarterly Annualised Plant Feed Rate
### Plant Capex

<table>
<thead>
<tr>
<th>Item</th>
<th>$M</th>
</tr>
</thead>
<tbody>
<tr>
<td>HMP Module</td>
<td>35</td>
</tr>
<tr>
<td>Incl. feed, product and reject conveyors</td>
<td></td>
</tr>
<tr>
<td>Live Ore Stockpile</td>
<td>3</td>
</tr>
<tr>
<td>Stockpile Feed Conveyors and feed diversion system</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>40</strong></td>
</tr>
</tbody>
</table>
## Plant Opex

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost $M/a</th>
<th>$/t</th>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labour</td>
<td>1.87</td>
<td>0.75</td>
<td>44%</td>
</tr>
<tr>
<td>Ferrosilicon</td>
<td>1.00</td>
<td>0.40</td>
<td>24%</td>
</tr>
<tr>
<td>Power</td>
<td>0.57</td>
<td>0.23</td>
<td>13%</td>
</tr>
<tr>
<td>Maint. consumables</td>
<td>0.50</td>
<td>0.20</td>
<td>12%</td>
</tr>
<tr>
<td>Other</td>
<td>0.30</td>
<td>0.12</td>
<td>7%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>4.24</strong></td>
<td><strong>1.70</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>
Net Reduction in Plant OPEX
Net Reduction in Plant Power

![Graph showing net reduction in plant power with different HMPReject Rates and production capacities.](Image)
Summary of Benefits

At 0.5Mtpa rejects

- Grinding Throughput: $0.56Mt/a
- Plant OPEX: $0.6M/a
- Plant Power: 2MW
- Tailings: 0.5Mt/a
- Water to Tails Dam: 410-460ML/a
Conclusions

• Pump fed HM cyclone proven on base metal at acceptable wear & operability

• Existing base metal HM design constraints overly conservative
  – plant able to operate at > 2 x design feed rate
  – actual operating parameters close to standard coal design parameters

• Actual CAPEX per tonne capacity significantly lower than previously assumed
Major Constraint considering HMS

- HMS on ROM generally requires crushing for sufficient feed liberation (≈-20mm)
- Not compatible with SAG/AG milling
- Could consider HMS on SAG/AG scats
HMS on Scats Potential

- Harder low grade material tends to concentrate in scats – high reject rate possible
- No de-slime screen or fines circuit required if scats report to HMS prior to pebble crusher
- Retrofit into existing SAG/AG circuit
- Needs Float/Sink testwork on scats to determine viability
HMS on Scats Possible Economics

• <$15M Capex for add-in simplified HMS plant treating 150-200tph scats

• Increase in SAG/AG new feed capacity of 94-125tph if
  – 50% reject rate for HM rejects grade<= flot tail grade
  – Rejects 25% harder than ROM
Acknowledgements

• MRM
• ACPS for permission to do different version of paper presented at ACPS 2014 Conference