Development and Implementation of the new 2240 kW (3000 HP) VERTIMILL® Grinding Mill for Newcrest Cadia Valley Operations

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Previous Scale Up

• Previous jumps
  – VTM-500-W => VTM-800-W or 60% increase
  – VTM-800-W => VTM-1250-W or 56% Increase
• Current Increase
  – VTM-1500-WB to VTM-3000-WB or 100%
• Previously looked at VTM-2000-WB and VTM-2500-WB but the economics were not there.
• Calculations for larger Vertimills have existed for 15+ years
Creating the VTM-3000-WB
Scale up Considerations

- Want to Keep existing Vertimill advantages:
  - Machine Simplicity
  - Long Wear life
  - Grind Efficiency

- Challenges
  - Torque and availability of drive components
  - Wear
  - Minimize Capital Cost
  - Maintainability
Creating the VTM-3000-WB
From a VTM-1500-WB to a VTM-3000-WB

<table>
<thead>
<tr>
<th>Key Figures</th>
<th>VTM-1500-WB</th>
<th>VTM-3000-WB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length (m)</td>
<td>4.57</td>
<td>6.92</td>
</tr>
<tr>
<td>Width (m)</td>
<td>4.37</td>
<td>6.36</td>
</tr>
<tr>
<td>Height (m)</td>
<td>14.22</td>
<td>17.59</td>
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<tr>
<td>Mill Mass (mt)</td>
<td>167</td>
<td>343</td>
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<tr>
<td>Charge Mass (mt)</td>
<td>130</td>
<td>260</td>
</tr>
<tr>
<td>Screw (mt)</td>
<td>9.3</td>
<td>23.6</td>
</tr>
<tr>
<td>Screw End Liner (mt)</td>
<td>3.5</td>
<td>8.4</td>
</tr>
<tr>
<td>Screw Flight Liner (mt)</td>
<td>2.7</td>
<td>4.5</td>
</tr>
<tr>
<td>Fully Lined Screw (mt)</td>
<td>32</td>
<td>60</td>
</tr>
</tbody>
</table>

VTM-3000-WB Fully Lined Screw
Newcrest Cadia Valley Operations

- Newcrest is a top 10 Global Gold company
- Operations primarily in Australia and Indonesia
- Cadia Valley Operations is near Orange, New South Wales, Australia
- Cadia Valley has two mines/concentrators: Cadia Hill (Low Grade) and Ridgeway (High Grade)
- The VTM-3000 was installed in the Ridgeway concentrator
Ridgeway Expansion

• Initial, Ridgeway was an AG- Ball Mill Circuit
• The circuit has been continuously modified to increase throughout and concentrate grade including:
  – Converted AG to SAG Mill
  – Added Pebble crushing
  – Added SMD and Vertimill in regrind
  – Added Vertimill in Secondary Grinding role (most recent)
• Ridgeway Mine was going to be going deeper and the future feed to the concentrator would be 21% harder (between 14-18 kWh/ton)
• More Grinding power was needed to offset harder ore and maintain feed size to flotation
Vertimill in Secondary Grinding

- Semi-Parallel with ball mill because cyclone under flow is split 7 ways
- Vertimill stream is pre-screen at screen with 6 mm apertures: Oversize (~10%) sent to ball mill, under size (~90%) sent to Vertimill
- Grinding duty
  - F80 – 600 µm
  - P80 – 150 µm
  - 200 mtph
- Unfortunately, due to circuit arrangement, the ball mill and Vertimill cannot be compared directly
Secondary vs. Tertiary Grind

- After success of VTM-1250-WB in Secondary, initial thoughts be site were to add more Vertimills in this function
- Metso recommended putting the VTM-3000-WB in Tertiary Grinding role for several reasons:
  - Vertimills are more efficient relative to ball mills in finer applications
  - Additional stage of classification
Newcrest Cadia
Ridgeway High Grade Concentrator Simplified Flow Sheet

Secondary VTM-1250-WB

Tertiary VTM-3000-WB

Regrind VTM-1250-WB
Metso Guaranteed Performance

#1 Mill capable of pulling a minimum of 2000 kW measure at the output of the motor shaft

#2 A volumetric capacity of not less than 1800 m3/h

#3 Mill shall produce a product particle size of not more than 80% passing (P80) 95 microns

#4 A mechanical availability of not less than 95%
Installation
Layout and Integration

• System designed to divert primary cyclone overflow to tertiary circuit. VTM can be bypassed.
• Newcreat decided to discharge the balls onto the floor in front of the mill.
• Since Vertimill maintenance is not very often, they will use mobile crane.
• Could have been a more compact installation.
Installation
Timing and Challenges

• Commenced Installation at the End of June 2010
• Several weeks lost to rain which significantly disrupted hanging structural steel
• Total Installation time of circuit was 8 weeks
• Only 3 weeks total spent on the mill installation
Commissioning

• During commissioning, Mill easily achieved guaranteed power draw of 2000 kW
• Vertimill pulled the 2238 kW after several months once it was fully loaded
• The VTM-3000-WB has the exact same relationship of power draw to media as smaller Vertimill, mechanical scale up validated
Media Charge and Power Relationship

Measured Data

- Power (kW)
- Power Factor
- Reducer Torque [kN-m]
- Predicted Output Shaft Torque [kN-m]
- Motor Power Draw [kW]
- Charge Level [mm]
- %FLA (% Full Load Amperage)

Mass of Grinding Media in VTM-3000-WB (metric tons)
Commissioning
Validation of Throughput

- Because of low reduction ratio and tertiary grinding function, the mill will have a very volumetric throughout which was a concern to Cadia
- Vertimill is not very limited like other grinding technologies on throughput
- Vertimill successfully continuously handled 1800 m3/hr

Top View of VTM-3000-WB Separating Tank
Grinding Evaluation

First Audit data

Design Conditions
- F80 – 151 microns
- P80 – 95 microns
- 715 mtph
- Predicted Vertimill SE of 2.92 kWh/mt using typical Vertimill selection methodology

⇒ BWio 13.67 kWh/mt

⇒ BWio 13.28 kWh/mt
⇒ 97% of prediction, 3% better than expected

Concentrator not yet fed with 100% hard ore and mill operated at lower power (slightly less efficient), so additional survey was carried out later
Grinding Evaluation
Second Audit data

Design Conditions
• F80 – 151 microns
• P80 – 95 microns
• Feed Rate 715 mtph
• Predicted Vertimill SE of 2.92 kWh/mt

⇒ BWio 13.67 kWh/mt

• Second Audit In February 2011
• F80 – 169.5 microns
• P80 – 97.4 microns
• Feed Rate ~718 mtph
• Operating Mill Power 2135 kW
• SE of 2.78 kWh/mt (Net)

⇒ BWio 11.35 kWh/mt

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8º International Mineral Processing Seminar
30 November – 2 December 2011
Sheraton Santiago Hotel & Convention Center, Chile
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Benefits of Tertiary Circuit

- Feed to Flotation (Vertimill circuit cyclone overflow) was more stable
- Flotation Feed particle size distribution was steeper than without the Vertimill circuit operating
- 2-4% recovery improvement from previous operation without the Vertimill, largely a result of a finer feed to flotation. They were previously running at the same feed rate, resulting in a coarse product
Future Work

- Test program conducted by JKMRC to commence in two weeks:
  - Evaluation of the effects of recycle pump on grind efficiency and product size distribution (recovery)
  - Evaluation of the VTM-1250-WB in Secondary grinding
Wear Performance

- First set of liners where changed after 9 months
- Could have lasted longer but were changed since the mill was open
- Current set on liners in mill have been running for 6 months, scheduled for change out in Feb 2012
- Wear performance of VTM-3000 exceeds all other VTMs at Cadia
- Availability Guarantee (> 95%) has been exceeded

6 Month Inspection, little wear
Conclusions

• The mill has been running since July 2010 without problems
• VTM-3000-WB was a complete success both mechanically and metallurgical
• VTM Scale up procedure validated
Acknowledgements

• Jason Robertson, Newcrest Mining Ltd.
• Matt Bird, Newcrest Mining Ltd.
• Kamran Kermanshahi, Metso
Thank You