CAHM Platform Technology
Project Update

Rob Stephens - CTTI
June 2020
Conjugated Anvil Hammer Mill (CAHM) Platform

CAHM + Hammer Retrofit = Simple Circuit
CAHM: Ported Variant

- Thin particle bed breakage mechanism
- Some shear
- Hammer rotates inside anvil
- Proprietary liner designs

Conjugate Anvil Hammer Mill (CAHM) Platform

MonoRoll Variant
<table>
<thead>
<tr>
<th>Performance Goal</th>
<th>Benefit</th>
<th>Impact</th>
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</thead>
<tbody>
<tr>
<td>Greater Grinding Efficiency (P,M)</td>
<td>↓ Energy Costs</td>
<td>↓ GHG and OPEX</td>
</tr>
<tr>
<td>Increased Reduction Ratio (P,M?)</td>
<td>Simplified Flowsheets</td>
<td>↓ CAPEX and OPEX</td>
</tr>
<tr>
<td>Coarser Feed (P,M?)</td>
<td></td>
<td>↓ Footprint</td>
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<tr>
<td></td>
<td></td>
<td>↑ Production</td>
</tr>
<tr>
<td>Reduced Auxiliary Equipment (P)</td>
<td>Simplified Flowsheets</td>
<td>↓ CAPEX and OPEX</td>
</tr>
<tr>
<td></td>
<td>↓ Recycle → ↓ Dust</td>
<td>↑ Occupational Health</td>
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<tr>
<td>Elimination of Grinding Media (P,M)</td>
<td>Avoided Cost?</td>
<td>↓ OPEX</td>
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<tr>
<td>Dry Grinding (P,M)</td>
<td>↑ Flotation Recovery</td>
<td>↑ Recovery</td>
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<td></td>
<td>Store After Grinding?</td>
<td>↑ Maintenance Flexibility</td>
</tr>
<tr>
<td>Sharper Particle Size Distribution (M)</td>
<td>↓ Energy Costs</td>
<td>↓ GHG and OPEX</td>
</tr>
<tr>
<td></td>
<td>↓ Slimes → Coarser Tails</td>
<td>↓ Tailings Risk</td>
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<tr>
<td></td>
<td>↓ Slimes → ↑ Recovery</td>
<td>↑ Recovery</td>
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</tbody>
</table>

- **P**: Process Variable
- **M**: Material Variable
Innovation – A People-Centric Process
Conjugate Anvil Hammer Mill
Platform Technology Team

Inventor & Product Developers
Lawrence Nordell
Sadaf Ghorbani
Forbes Wilson
Rob Stephens
Mohammad Mousaviraad

Project Manager
Gillian Holcroft
Project Sponsor
Carl Weatherell

Testing Experts
Gianni Bartolacci
Christian Rochefort
Andreia-Rosa Carolina
Jean Robitaille

First Adopters
Paul Cousin
AGNICO EAGLE
John Middlemiss
GLENCORE Canada
Dominic Fragomeni
Michal Kowalczyk
KINROSS
Myriam Jebali
Newmont
Frank Roberto
Aidan Giblett
Teck
Tom Robinson
Vale
Manqiu Xu

Process Expert
Steve Wilson
Marketing
Andro Kobilic

Government
QUEBEC INNOVE
Natural Resources Canada
CAHM Platform – How?

$6.5M Cash & in-kind

Competitive Analysis and Go-To-Market Strategies underway

CAHM
- Prototype is 50 t/h (1200 t/d)
- Expand width or both width & diameter to increase capacity (more slots)

MonoRoll
- Continue testing 40”x60” ball mill (1.5 tph)
- Retrofit larger ball or rod mills

Exploring Designs Virtually

3.2 times more energy efficient
>2 times higher reduction ratio in single pass.
1.5 times higher throughput with same efficiency
CAHM Platform – Machine Design & Fabrication

CAHM

MonoRoll
Baseline & Performance Testing

Ore & Ore Characterization

- 100+ t of Agnico Eagle moderately hard ore received & prepared → Meets Crush It! Challenge parameters
- Standard Ore comminution test procedures completed

HPGR Benchmarking

Ball Mill Benchmarking
Other Benefits – The Bigger Picture

Mining Industry Innovation Ecosystem
• Demonstrating we can work together to deliver complex projects to address our gnarliest challenges
• Building trust – people, companies, ecosystem

CMIC - Connect • Catalyze • Transform
• Zero waste mining → ≥50% footprint reduction by 2027
• Systems and processes to deliver platform projects

DEM Modelling
• Validating likely game-changing technology
  • Design and analysis for new comminution machines
  • Improvements of existing comminution equipment
Acknowledgements

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• CMIC

• The companies

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