Collaborative Research on Coarse Particle Processing

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Context - Global Copper Industry

• The global consumption of copper over the next 25 years will exceed all the copper ever mined to date – Robin Batterham, 2015

• BUT – the quality of deposits is decreasing, and the orebodies are becoming increasingly more complex and difficult to process

• Mineral flotation is one of the primary processes for upgrading metalliferous ore bodies

• The advent of technology for processing coarse particles by flotation as one of the foremost areas where significant improvements in mineral processing are possible – Robin Batterham, 2013
Coarse particles recovery is a well known problem in mineral flotation.

Poor recoveries are typically caused by:
- Poor suspension
- High levels of particle/bubble detachment
- Poor liberation
- Poor reagent coverage
- Poor froth transport
- Lack of predictive capability

In some operations, 50% of all losses to tailings occur in the +75µm size fraction – e.g. Vale Inca’s Thompson Mill operation, (Dai et al., 2008)
Processing Coarser Particles

• Increased plant **throughput** (up to 25% for copper ore)
• **Energy savings**, particularly in comminution due to reduced grinding effort
• Improved **de-watering** performance
• Reduction on **Acid Mine Drainage** risk
• Potential for increased revenue due to **reduced losses** (up to 26% reduction in losses)
• Viability of **access to new ore bodies** that otherwise may be deemed uneconomic

**Key focus area for mineral processing research and development**
Eriez HydroFloat™ Technology

ADVANTAGES
• Fluidised bed suspension – no mechanical agitation
• Low turbulence – Decreased detachment
• Intense interaction between bubbles and particles - Improved attachment
• Fluidization water increases particle retention time in the cell
• No froth layer – no froth transport losses

CHALLENGES
• Requires de-slimed feed (1:6 ratio)
• No existing model for HydroFloat™ performance
• No developed understanding of how it fits within existing flotation circuits
Eriez HydroFloat™ Performance

- Highly promising results from early installations – Newcrest
  - Significant improvement in coarse particle recovery (100 – 600 µm)
  - Fills in the performance gap between conventional flotation cells and gravity separators (jigs, DMS, etc).

Seaman & Vollert, 2017
The Ever-present Challenge of Funding….

<table>
<thead>
<tr>
<th>Traditional Academic Funding</th>
<th>Industry Funding</th>
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</thead>
<tbody>
<tr>
<td>Highly fundamental research</td>
<td>Applied research</td>
</tr>
<tr>
<td>KPIs – Journal publications</td>
<td>KPIs – Outcomes directly applicable onsite</td>
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<tr>
<td>Timeline – several years</td>
<td>Timeline – 6 months</td>
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- What about something in between?
  - Applied research not seen as “scientific” enough for academic funding
  - Too removed from day to day practice for industry funding

- **Multi-party collaborative research programs**
  - Several companies jointly fund a long term (3 – 5 years) research program
  - E.g. AMIRA P9 project series, currently running for 50 years
**Proposed Collaborative Consortium**

- Collaborative Consortium for Coarse Particle Processing Research (CPR)

- Aims to enable efficient and co-ordinated research efforts aimed at producing practical and applied solutions to industrial issues surrounding coarse particle processing

- Particular research focus on the Eriez HydroFloat™ technology, with participation by Eriez Flotation Division

- Seed funding for program establishment provided by the Complex Ore Bodies Program
Several candidates for research projects have been put forward.

Further consultation will be sought as to the research priorities of individual sponsors.

Choice of which projects form part of Core vs Individual research will be made by the Steering Committee.

Three project have already started – through Early Sponsorship.
Development of a Semi-empirical Model of the HydroFloat™ Cell

Student: Konuray Demir, Supervisor – Kym Runge, Angus Morrison, Cathy Evans, Jaisen Kohmuench
Sponsor - Eriez FD & Newcrest

HydroFloat™ is a new technology but there is no model to predict its performance. The aim of this study is to develop a semi-empirical model which can predict the HydroFloat™ cell’s performance by using stream properties and key operational parameters.
Work Plan (1/2)

- Performed a site based pilot plant study of the HydroFloat™ with Eriez
- Formulation of the preliminary model structure in Matlab
- Validation of the existing settling & fluidisation models
Work Plan (2/2)

• Design, Procurement & Construction of a HF-150 pilot rig

• Coding of automation software using NI LabView

• Purchase of a probe for bubble size measurement & development of analysis script

• 3 month site program at Newcrest's Cadia operation, commencing January 2020
HydroFloat™ Waste Rejection Circuit Options
Student: Hayla Miscela, Supervisor – M. Yahyaei & K. Runge, Sponsor - Newcrest

Questions to be Addressed:

- How do we maximise mineral surface exposure at a coarse size?
- How do we produce the coarse and narrowly sized feed required by the HydroFloat™?
- How does the circuit cater for the large amounts of water in the HydroFloat™ concentrate?
- How is it best incorporated into our conventional grinding circuits?
- Can novel grinding/classification equipment be utilised in new circuit designs?
HydroFloat™ Waste Rejection Circuit Options

Initial Project Activities

• Hayla Miscela recruited and commenced studies in Oct 2019

• Student literature review underway

• Review of existing Newcrest piloting information

• Negotiation with Loesche, Gekko and others to arrange an assessment of their new technologies
Objective:

• Provide experimental insights into the system hydrodynamics
• Evaluate alternative operating and design options
• Collect the experimental data appropriate for use in a parallel computational modelling project (to assist in model development and validation)

Scope of Work:

• Construct two scales of laboratory machine
• Measure the performance and bed behaviour in the laboratory-scale cells under various feed, operating & design conditions.
• Measure the detailed motion of bed particles by class in the laboratory-scale cells using PEPT.
What of the CPR Program?

- Currently in the process of drafting legal agreements
- Commitment from Eriez Flotation Division
- Signed agreements with two mining companies as early sponsors
  - Anglo American
  - Newcrest
- Contract negotiations with:
  - Four more mining companies
  - Two equipment manufacturers
  - One technical service provider
  - One reagent supplier
- Program is expected to kick off in February 2020
Thank you

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