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Collaborative Research on Coarse Particle Processing

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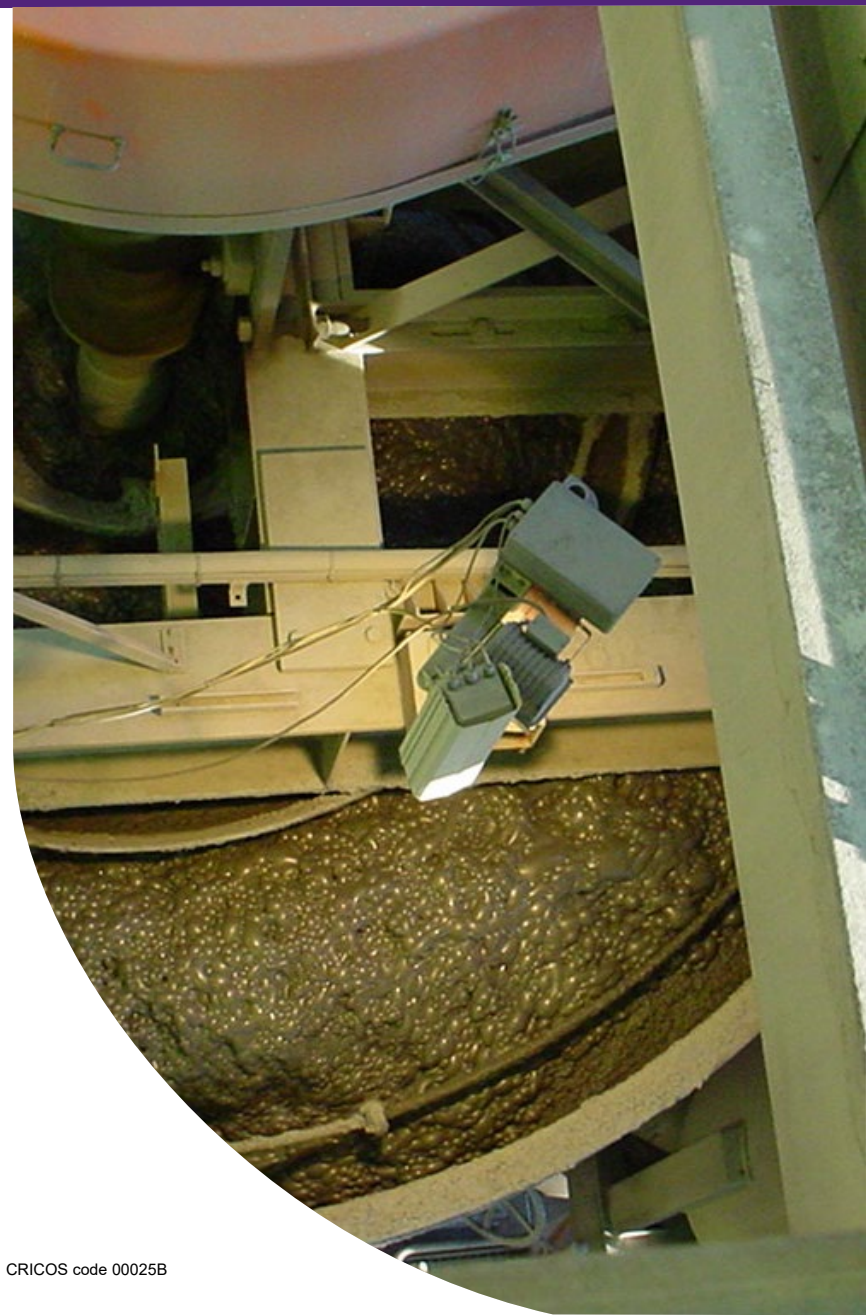
Context - Global Copper Industry

- 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

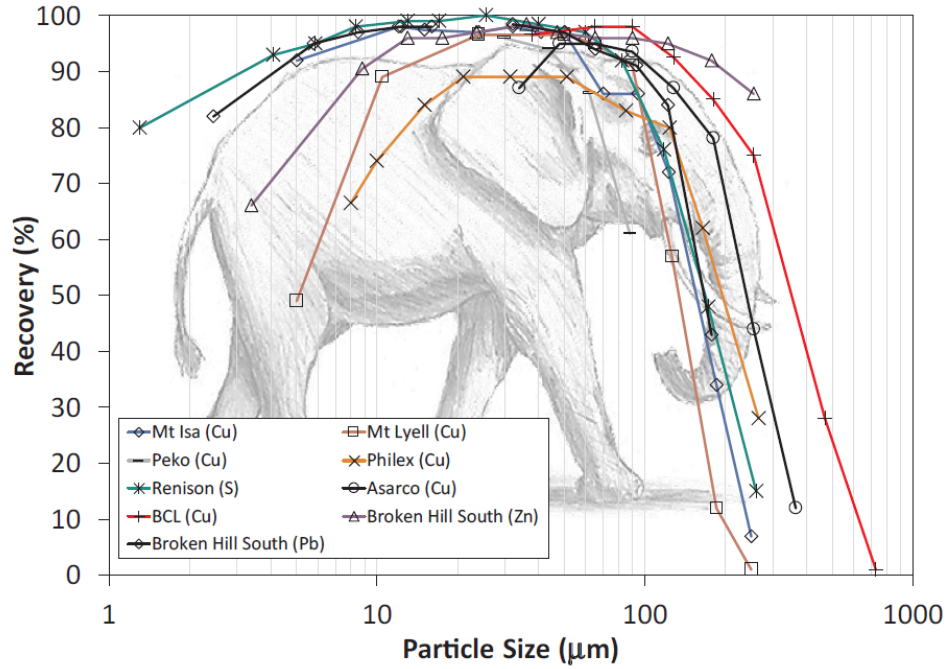


Processing Coarser Particles

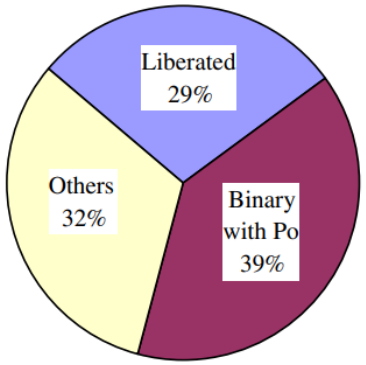
- Coarse particles recovery is a well known problem in mineral flotation

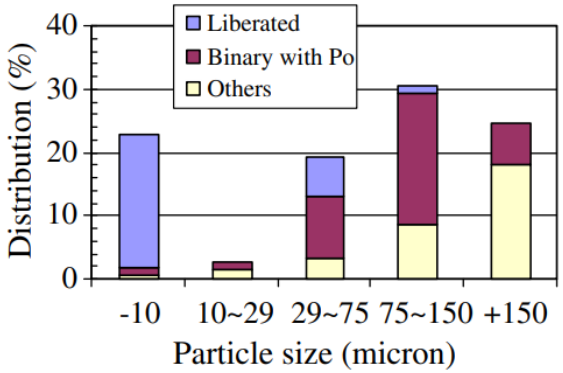
- Poor recoveries are typically caused by:
  - Poor suspension
  - High levels of particle/bubble detachment
  - Poor liberation
  - Poor reagent coverage
  - Poor froth transport
  - Lack of predictive capability

- 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)



Kohmuench et al, 2018





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

Image by Eriez FD

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

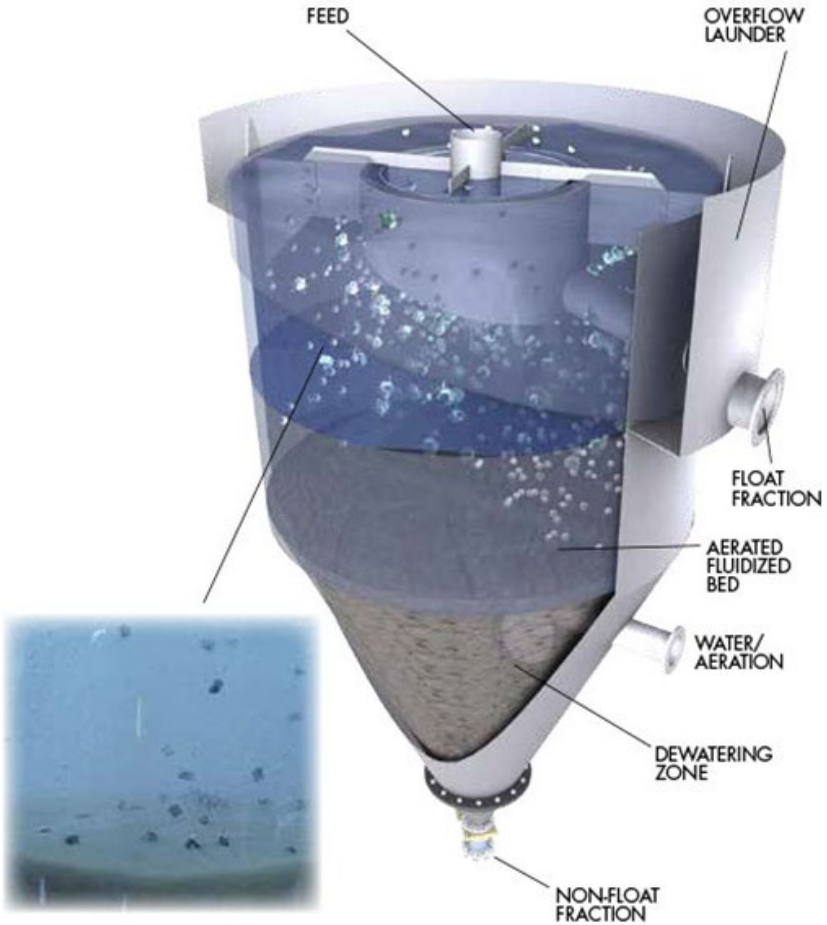
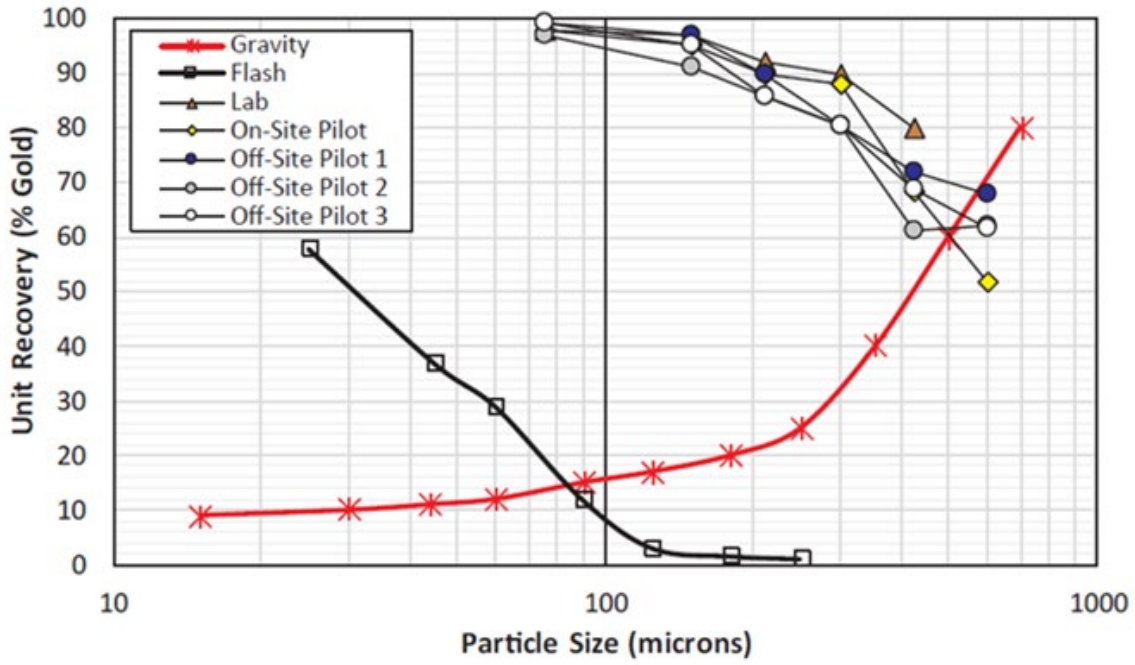


Image – Eriez FD

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….

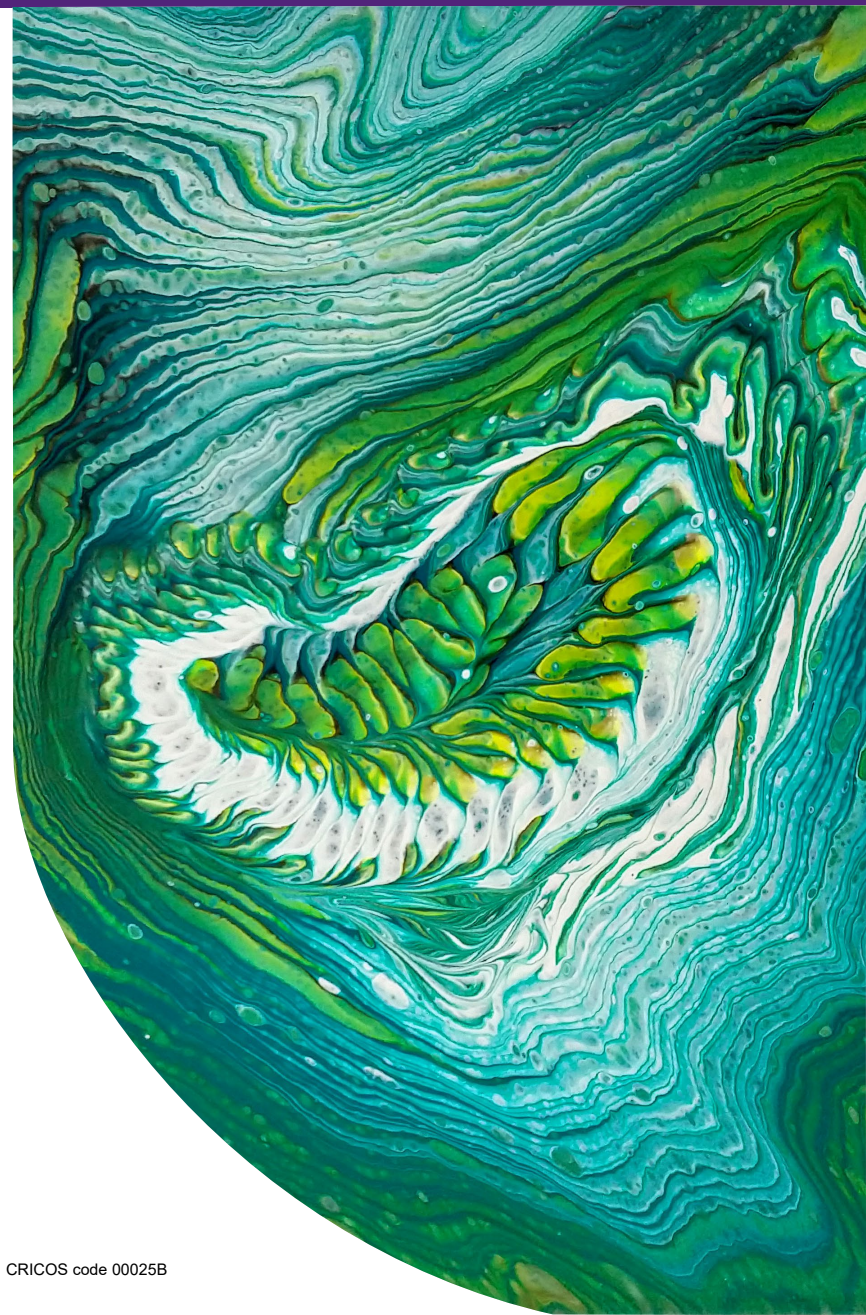
Traditional Academic Funding	Industry Funding
Highly fundamental research	Applied research
KPIs – Journal publications	KPIs – Outcomes directly applicable onsite
Timeline – several years	Timeline – 6 months

- 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

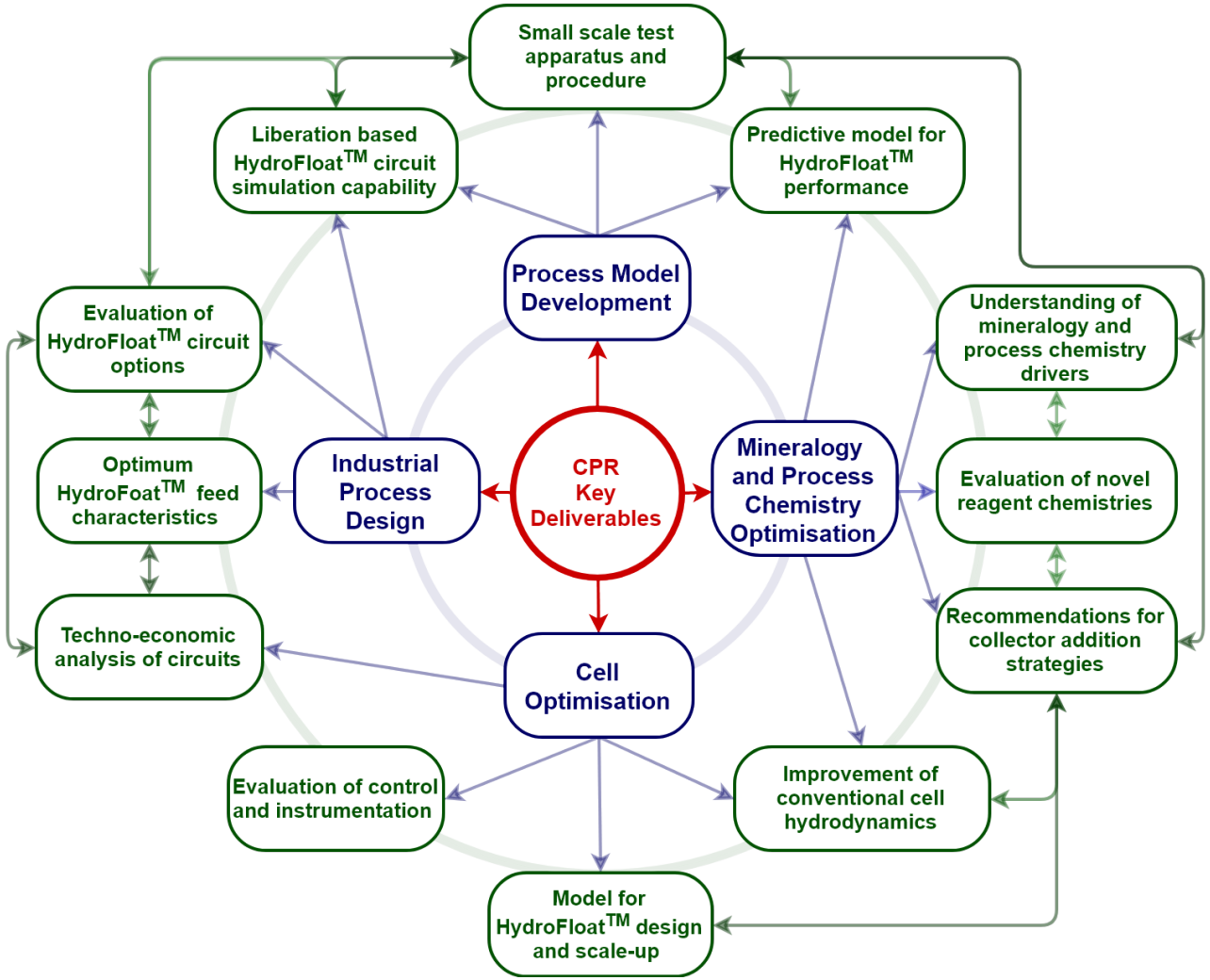
- **Multi-party collaborative research programs**
  - Several companies jointly fund a long term (3 – 5 years) research program
  - E.g. AMIRA P9 project series, currently running for 50 years

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



Proposed Projects

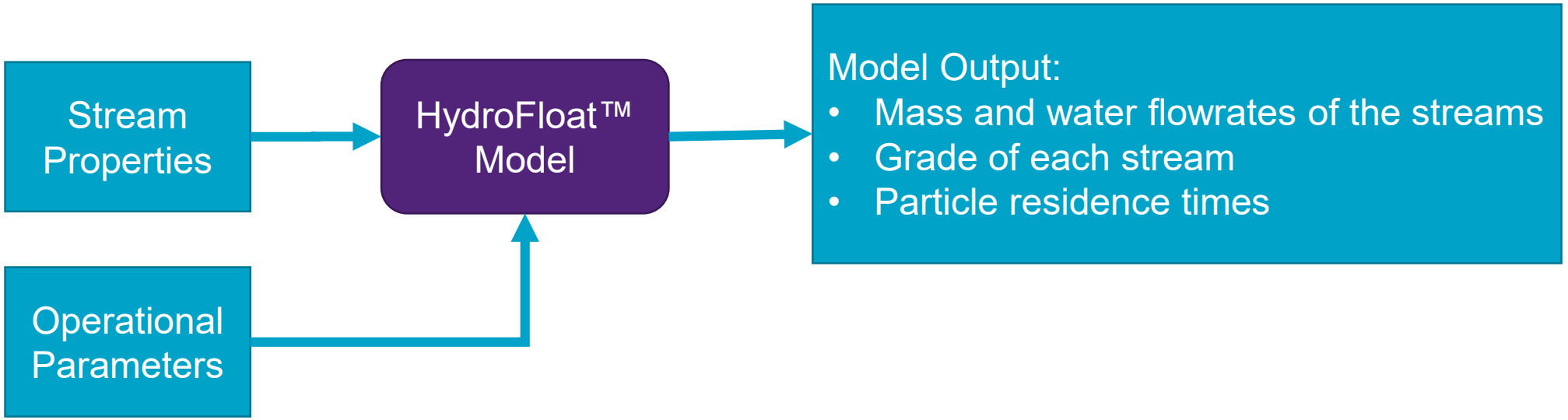


- Several candidates for research projects have been put forward
- Further consultation will be sought as to the research priorities of individual sponsors
- Choice of which projects form part of Core vs Individual research will be made by the Steering Committee
- Three project have already started – through Early Sponsorship

Development of a Semi-empirical Model of the HydroFloat™ Cell

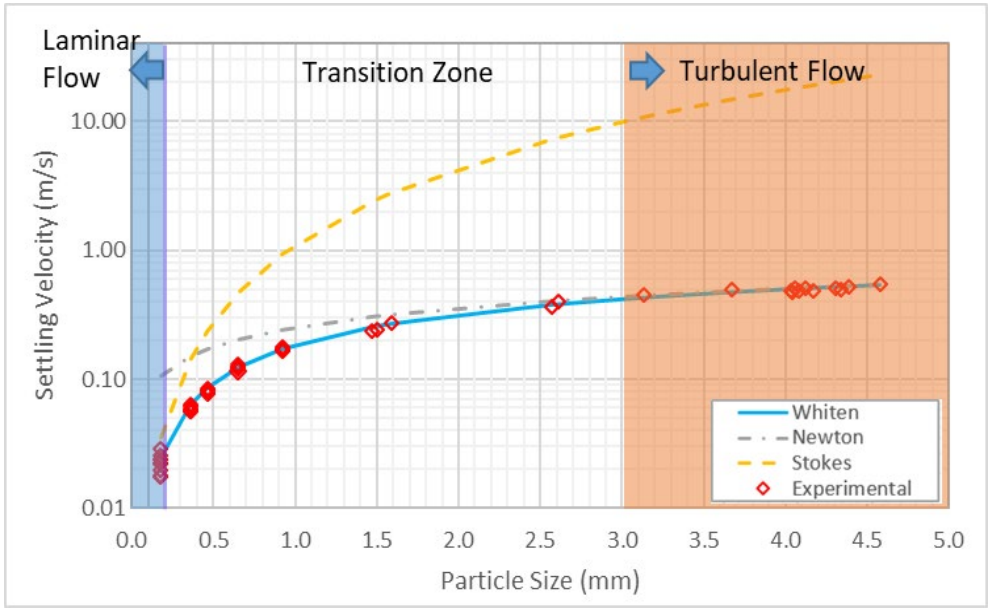
Student: Konuray Demir, Supervisor – Kym Runge, Angus Morrison, Cathy Evans, Jaisen Kohmuench
Sponsor - Eriez FD & Newcrest

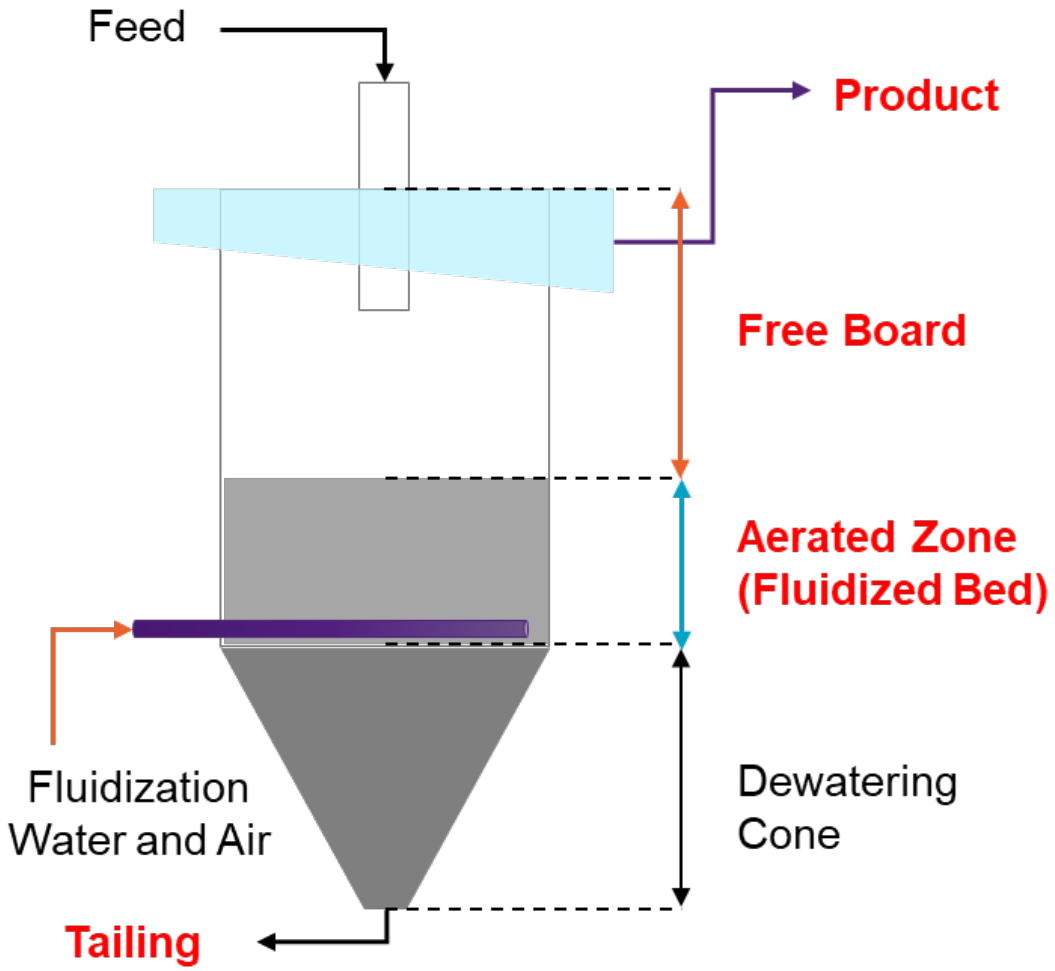
HydroFloat™ is a new technology but there is no model to predict its performance. The aim of this study is to develop a semi-empirical model which can predict the HydroFloat™ cell's performance by using stream properties and key operational parameters.



Work Plan (1/2)

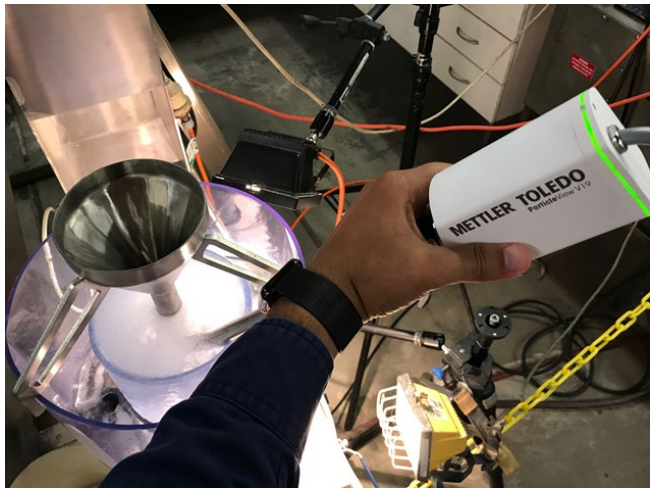
- Performed a site based pilot plant study of the HydroFloat™ with Eriez
- Formulation of the preliminary model structure in Matlab
- Validation of the existing settling & fluidisation models

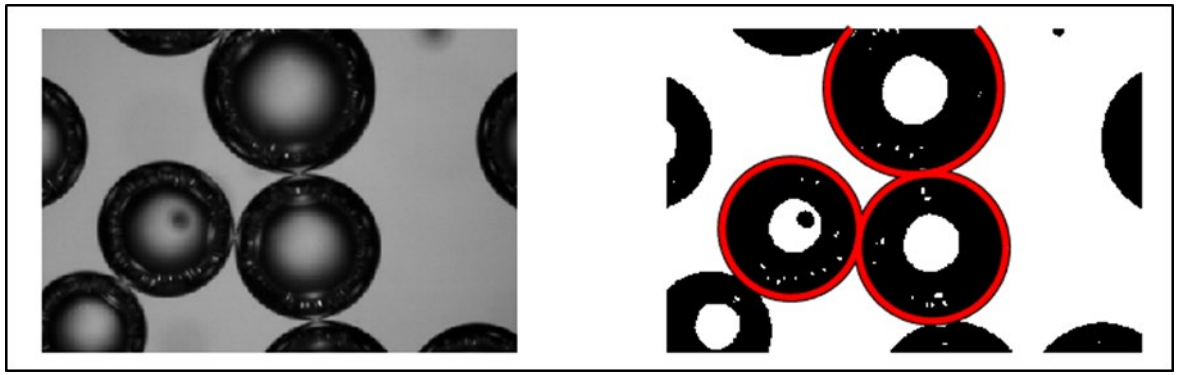




Work Plan (2/2)

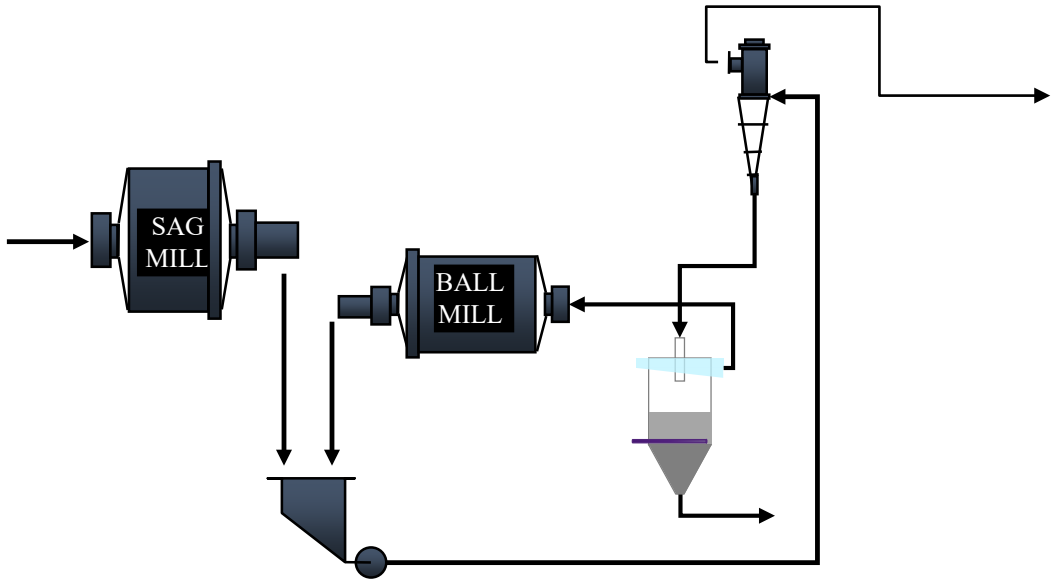
- Design, Procurement & Construction of a HF-150 pilot rig
- Coding of automation software using NI LabView
- Purchase of a probe for bubble size measurement & development of analysis script
- 3 month site program at Newcrest's Cadia operation, commencing January 2020





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

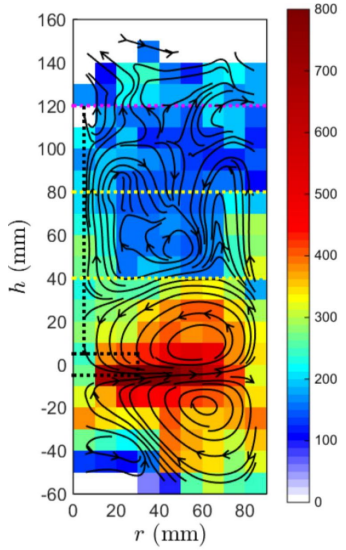
Initial Project Activities

- 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

Vertical Roller Mill - Loesche

Experimental Characterisation of the HydroFloat™

Student: Matthew Dzingai , Supervisor – Angus Morrison & Tom Leadbeater, Sponsor - Anglo American



Objective:

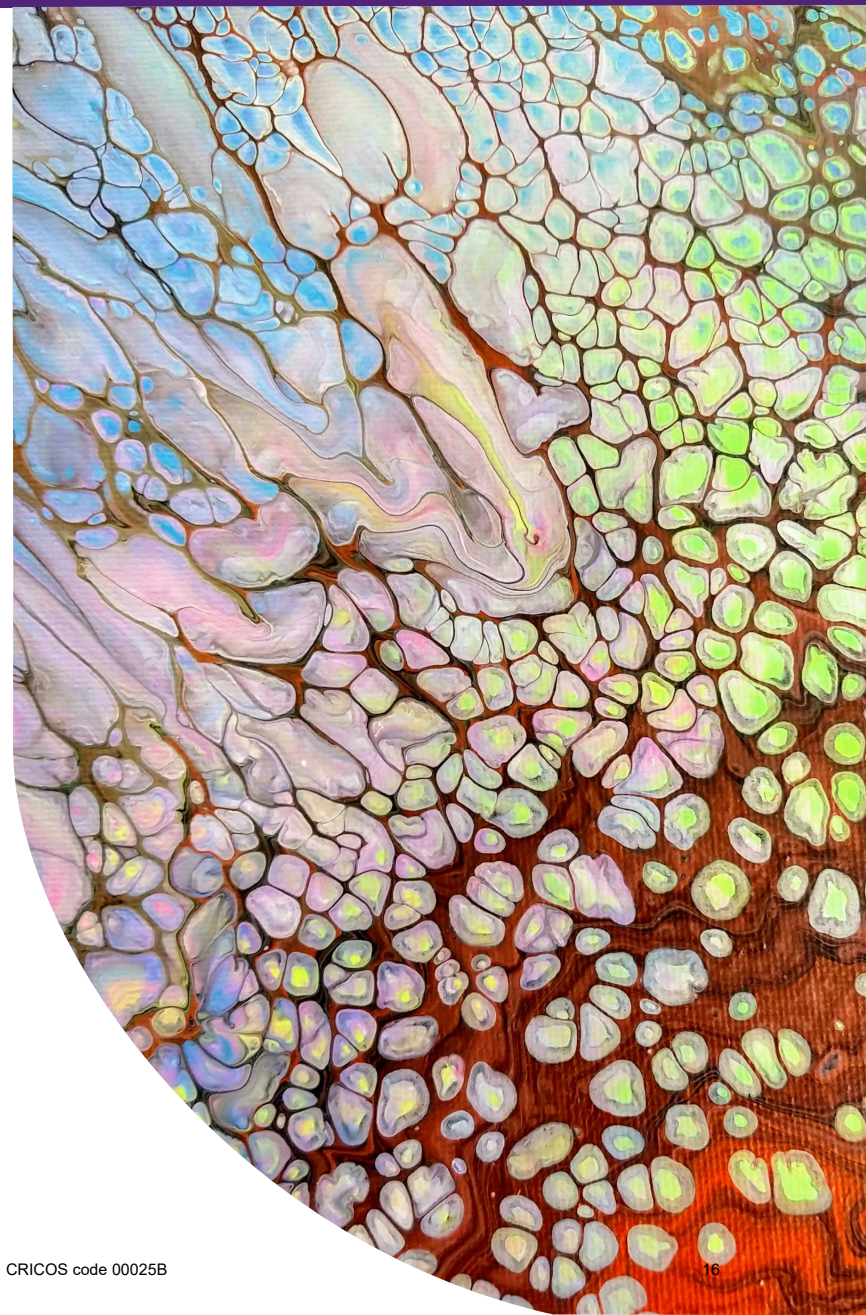
- Provide experimental insights into the system hydrodynamics
- Evaluate alternative operating and design options
- Collect the experimental data appropriate for use in a parallel computational modelling project (to assist in model development and validation)

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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