Optimizing froth area of the flotation cell

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Today's Speaker

Jason Heath

- 13 years of experience in mining industry in Australia and East Asia in gold and base metal flotation operations
- Production, project and technical sales roles
- Particular focus on flotation for the last 7 years
- Hobbies outside of work include cycling, martial arts and raising kids

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What does this training offer me?

Are you on top of your Froth Carry Rate?

Do you know that froth crowding can be modified to optimize froth recovery?

Are you aware that collecting froth is like collecting money?

If you answered “NO” to any of these questions, you NEED to watch this…

A better understanding of froth crowding and launders can improve your situation

Common Froth Challenges

- Variation in ore mineralogy and/or grade affecting froth behavior
- Froth recovery in the first cell with slurry containing a high proportion of fast floating minerals
- Froth recovery when targeting leanly liberated sulphide minerals in a scavenging duty
- Sticky or tenacious froths

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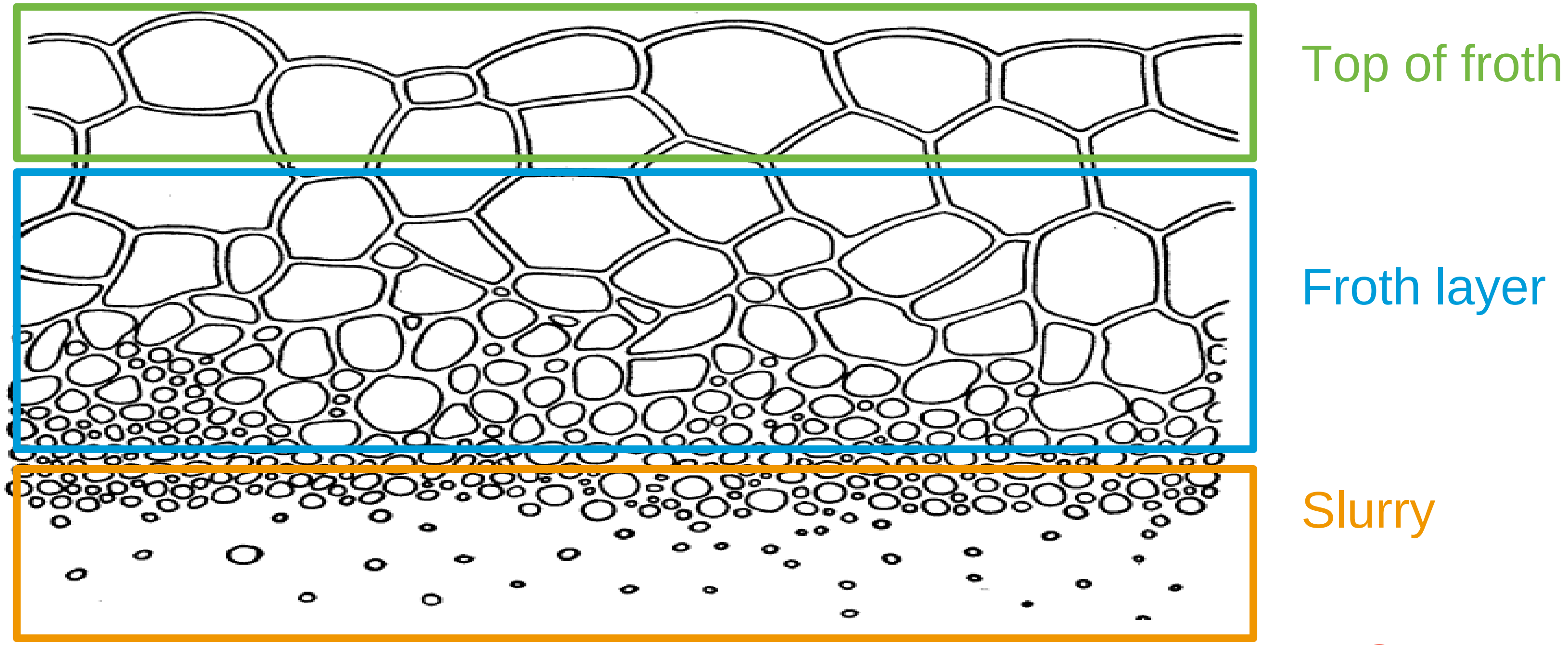
Revision: Requirements of a Flotation Cell

- Mix the slurry and keep solids in suspension (no sand at the bottom).
- Disperse air into slurry.
- Create circumstances for the engagement and attachment of particles and bubbles.
- Create circumstances to separate the bubble-particle agglomerates from the rest of the slurry.
- Create an environment for a stable froth to form with the upper most layer separated from the tank.

What is Froth?

- Three phase mixture of solid, water, and gas
- Properties vary considerably depending on: type of solids, solids particle size, chemicals (reagents) in water and on solids, etc.
- Ideally, target minerals are concentrated to the top of the froth for removal



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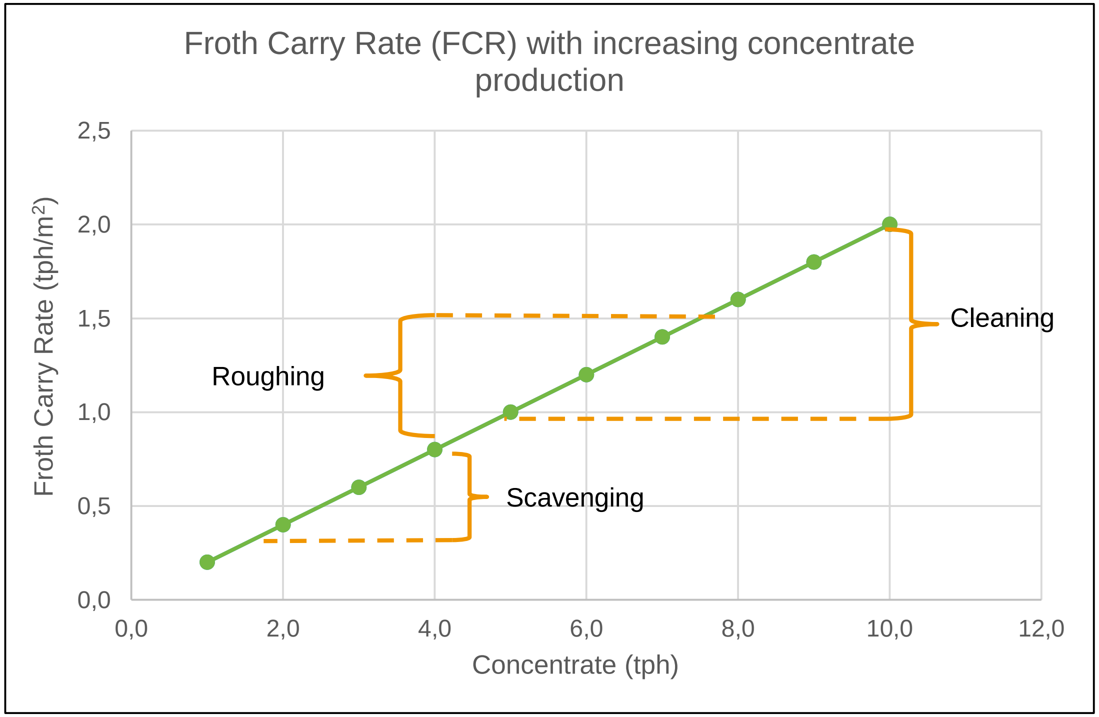
Concept of Froth Carry Rate

- As froth is mostly made up of air by volume, there is a physical limit to how much material it can support.
- This gives rise to the concept of Froth Carry Rate (FCR).
- FCR is the dry mass of concentrate removed from the flotation cell, per metre squared of froth area, per hour ($t/m^2.hr$ or tph/m^2)



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Froth Carry Rate Guidelines

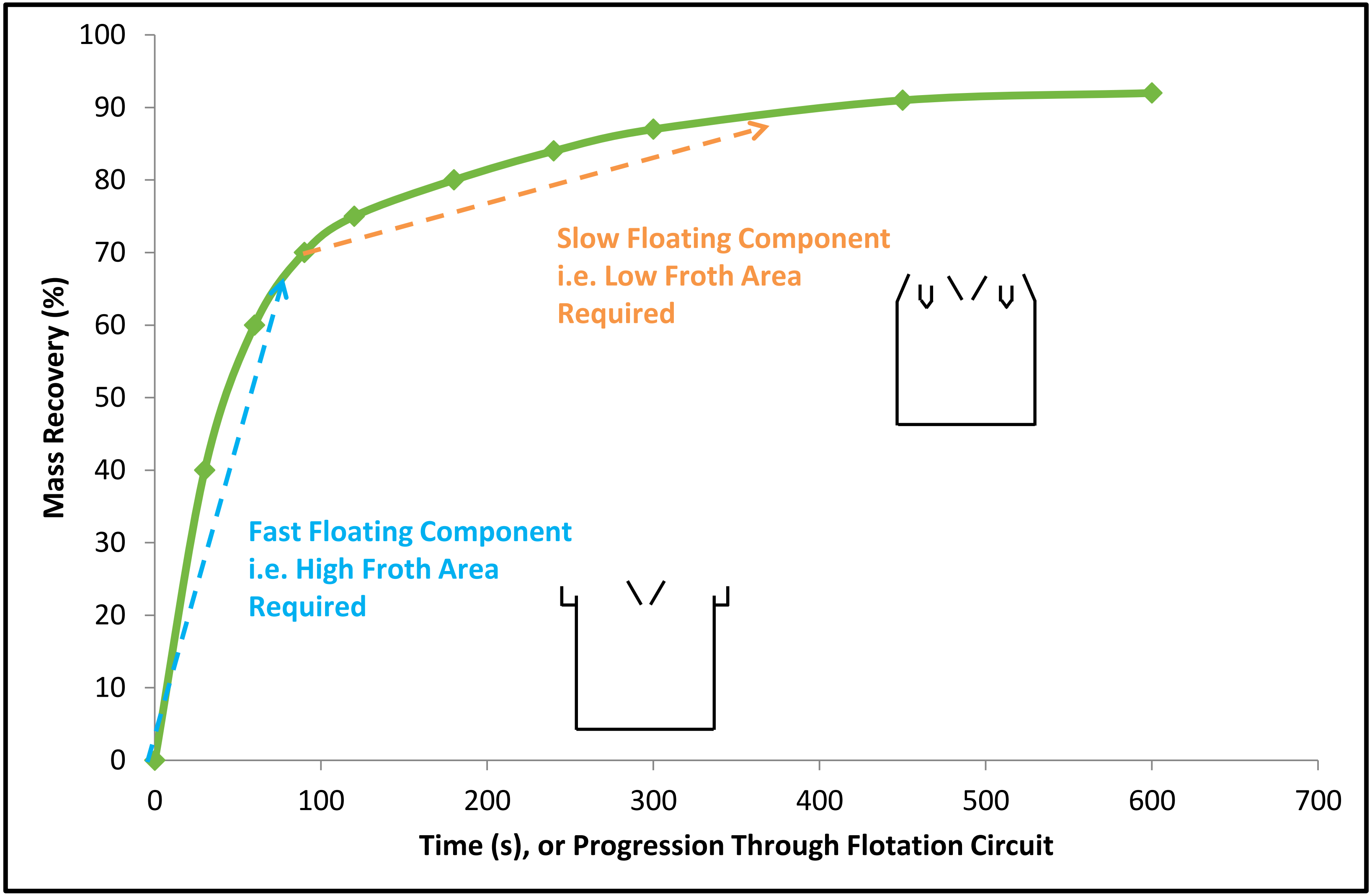
- Based on anecdotal operating plant performance and surveys, design guidelines are established for FCR for different flotation duties:

Duty	Rougher	Scavenger	Cleaner
Froth Carry Rate (tph/m^2)	0.8 – 1.5	0.3 – 0.8	1.0 – 2.0

- These design guidelines are used in plant design to correctly select the flotation cell sizes required, and the degree of froth crowding.

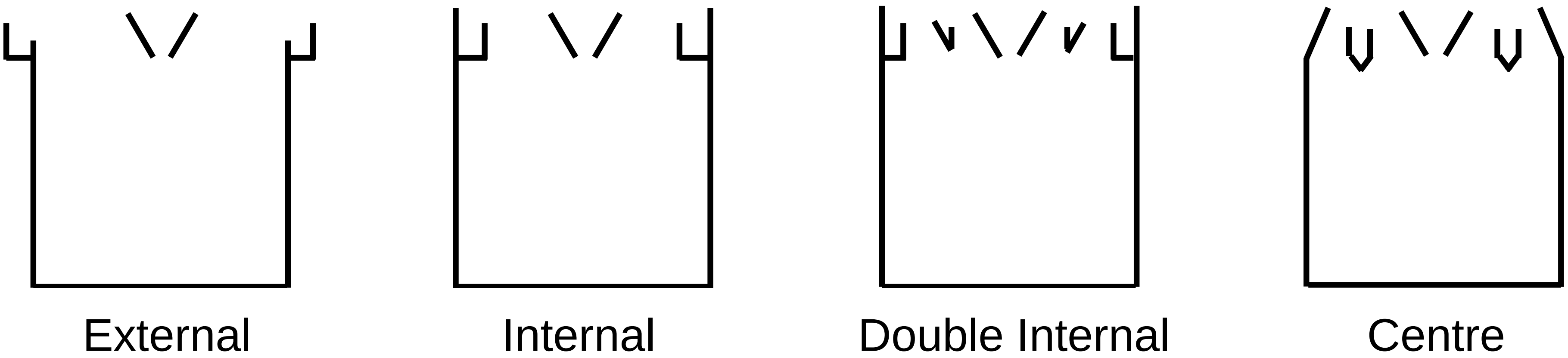
- They can also be used to evaluate if your existing flotation cell froth area is over or under loaded!

Typical Rougher Flotation Response



Types of Flotation Cell Launders

- A range of flotation cell launder types exist and these have varying froth surface areas. Consider the following same size flotation cells:



- For ore with fast and slow floating components, which launder would you want in the front and which towards the back of the circuit?

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FCR Implications

- FCR too low:
  - low froth solid loading
  - weak/brittle froth which readily collapses
  - poor transport of particles to launder lip
  - probability of particle drop back increased

- FCR too high:
  - high froth solid loading
  - may have froth collapse due to the weight of particles on froth, or uncontrollable froth
  - poor transport of particles to lip, or
  - low froth residence time, low froth drainage => gangue entrainment

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Measuring FCR in a plant

- The FCR in your plant can be measured with timed lip surveys.
  - measure the con produced from a portion of the cell lip, in a given (measured) time period,
  - divide con produced by the cell froth surface area,
  - normalise for the entire lip length, and on an hourly basis.
  - inner and outer lip samples should be collected and handled separately.
- E.g: 1 kg con taken in 7.5 s, using a sampler width = 0.3 m.
  - 1.0 kg in 7.5 s = 0.48 t/h (per 0.3 m of lip)
  - = 9.6 t/h for entire lip (assume outer lip length = 6.0 m)
  - = 0.80 tph/m^2 (assume outer froth area = 12 m^2)

  - This is for the outer area, and would need to be repeated for the inner area.

Manipulating FCR

- Booster cone adjustment
  - Subtle adjustment up/down
- Air flow rate set point
  - Quantity of air added to the cell
- Reagent dosage set points
  - Controlled collection of target minerals.

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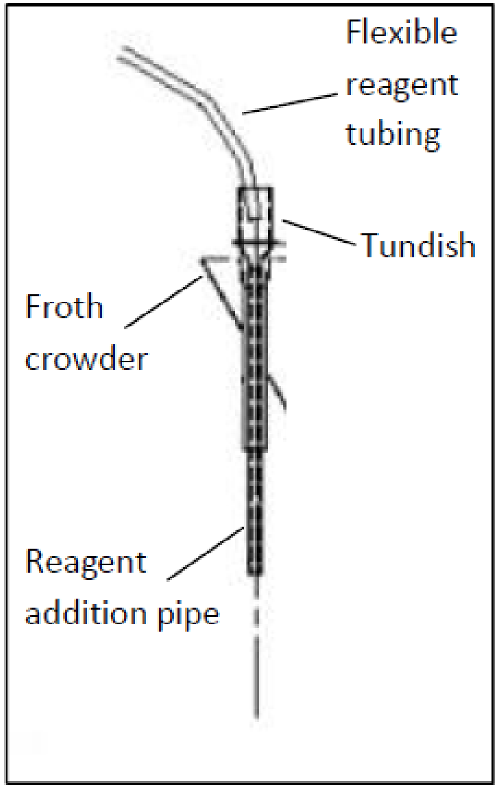
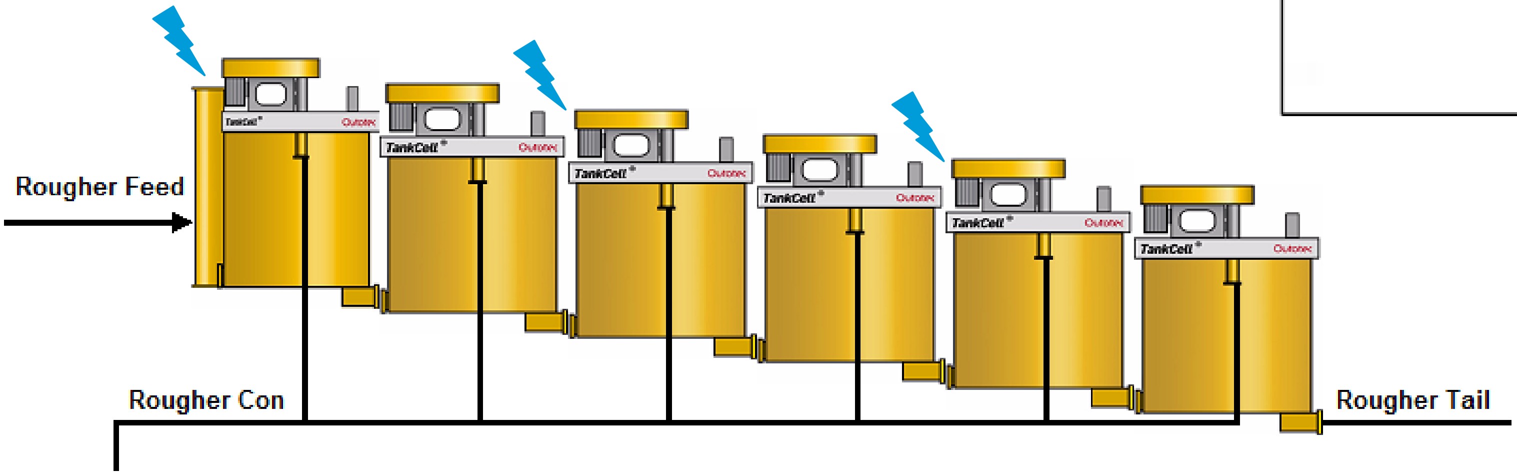
Adjusting FCR

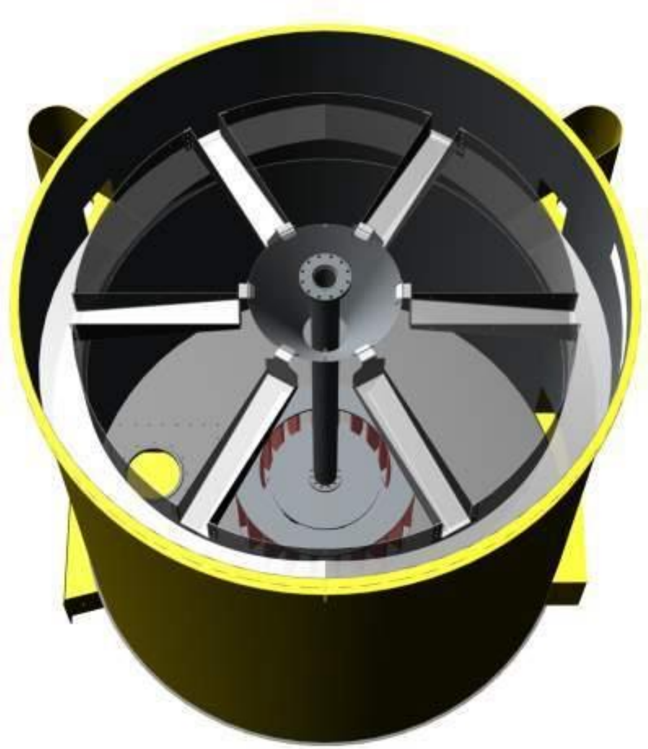
- Optimising reagents:
  - Correct addition of reagents
    - i.e. using reagent tundish and addition pipes
  - Staged addition of reagents
    - Especially for large cells





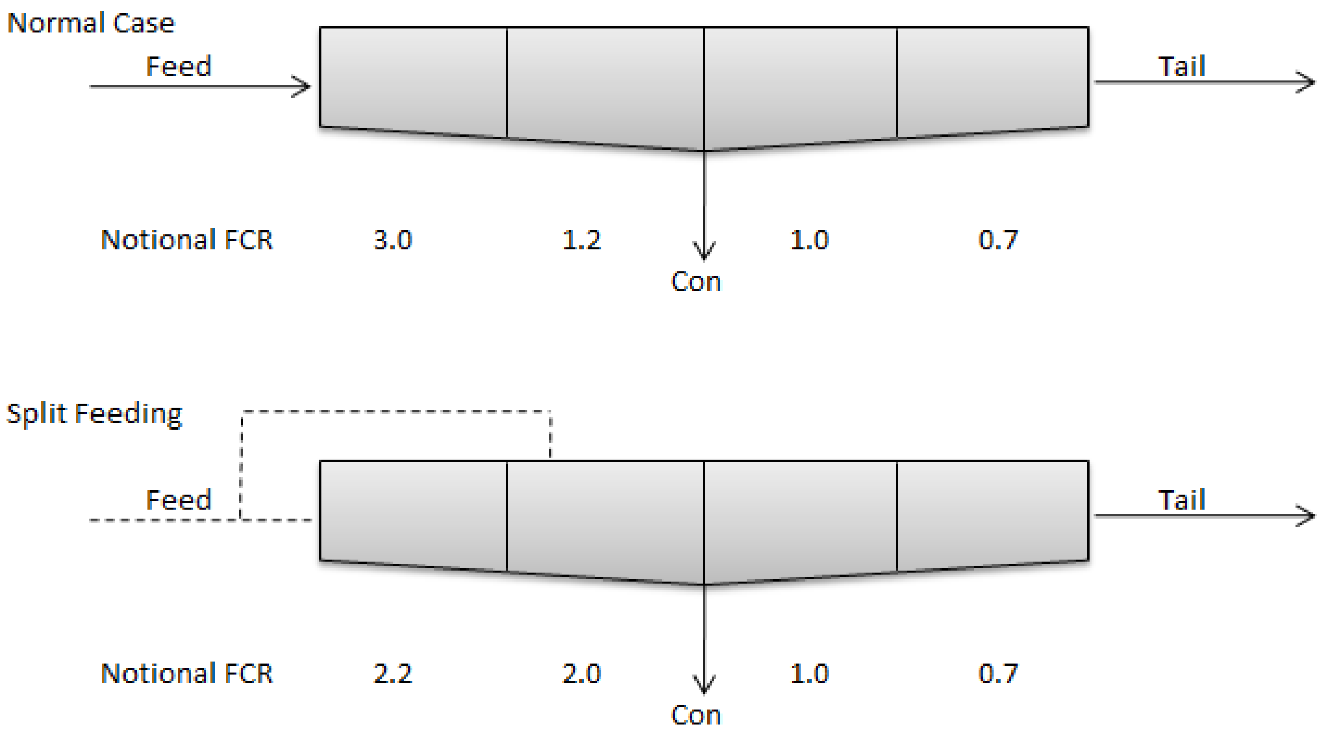
Cell Crowding Adjustment

- Cell crowding can be physically modified.
  - Addition of radial crowders, or even installation of new crowding



Reducing FCR

- Staged Reagent Dosing
  - Starvation collector dose strategy down flotation circuit => limits mass pull
- Split Feeding
  - A portion of the fresh feed is diverted directly to second cell:



Case Study: Australian Au Concentrator

- Gold flotation circuit (pyrite)
- Rougher-Scavenger configuration, using OK cells
- OK cells have quite large froth surface area
  - => Low FCR in Scavs
- Outotec solution was to retrofit curved crowders to the OK cells.

- After the crowders were installed, client reported recovery increase of 4% (absolute basis) for the Rougher-Scavenger circuit. Overall plant recovery increased as well.

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Case Study: Australian Cu Concentrator

- Primarily a chalcopyrite flotation circuit.
- Rougher-Scavenger configuration, using large Tank Cells.
- Prevailing feed grade much lower than when plant originally constructed
  - => Less mass recovered in the Scavs
  - => Low FCR in Scavs
- Outotec solution was to retrofit radial crowders to the cells.

- Client reported that the froth stability and cell performance improved with the crowders installed.

Before

After

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Further reading

- Bourke, P., 2005, Selecting Flotation Cells: How Many and What Size?, in AusIMM Bulletin May/June, pp 47-48.
- Murphy, B. & Heath, JL., 2013, Selection of Mechanical Flotation Equipment, in Proceedings Metcon 2013, Davao, Philippines.
- Achaye, I. Wiese, J. & McFadzean, B., 2015, Effect of particle size on froth stability, in Proceedings Flotation ‘15, Cape Town, South Africa.

Summary

- Importance of Flotation Cell froth crowding and launder design
- Different crowding options and launder designs available
- Implications on Froth Carry Rate and importance to flotation cell performance
- Options to modify the Froth Carry Rate in practice, including physical changes

Webinar's to come

If you enjoyed today's talk there are more detailed sessions planned on each of the topics touched on here today

June 3	Best maintenance practices to give best metallurgical performance in flotation – flotation maintenance practices
July 8	Boosting flotation productivity with modern technology – modernization and upgrade opportunities
August 5	Stabilization versus optimization – insights to flotation process control

Recording available online www.outotec.com/webinars:

Finding and eliminating bottlenecks in flotation plants

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Contact us

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