

**IECMS  
2021**

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**Fine, coarse and fine-coarse particle flotation in mineral processing with a particular focus on the technological assessments**



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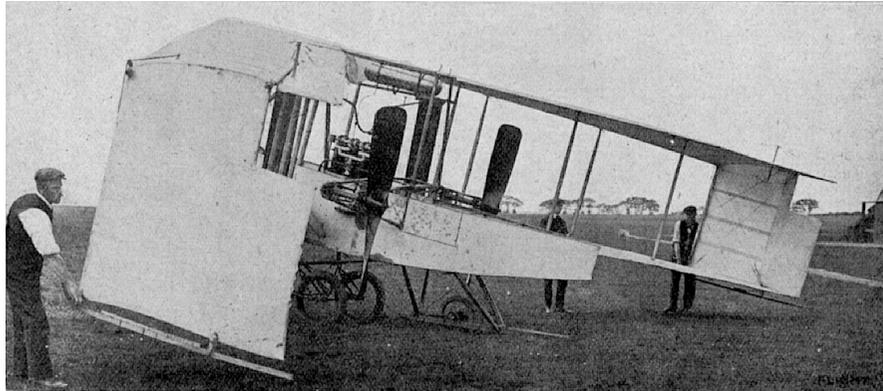
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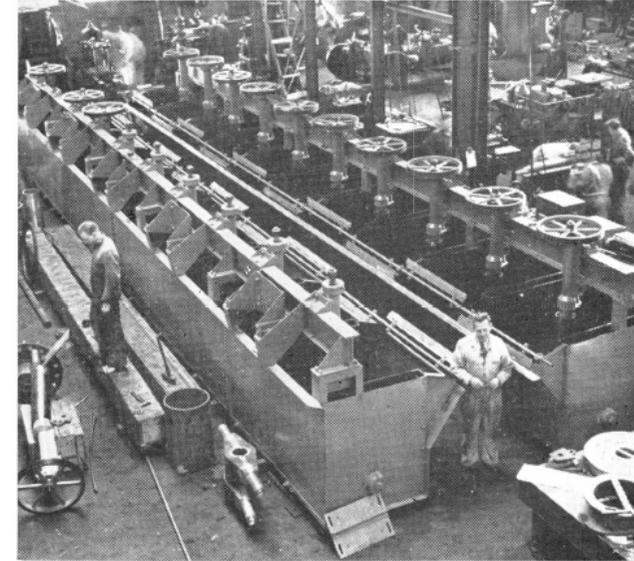
<sup>3</sup> Maelgwyn Mineral Services Ltd, Ty Maelgwyn, 1A Gower Road, Cathays, Cardiff, CF24 4PA, United Kingdom;

\* Corresponding author: [a.hassanzadeh@gmx.de](mailto:a.hassanzadeh@gmx.de)

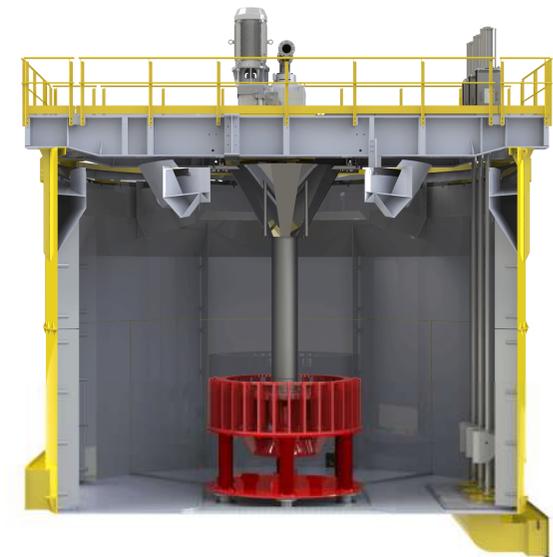
# 1903-Airplane



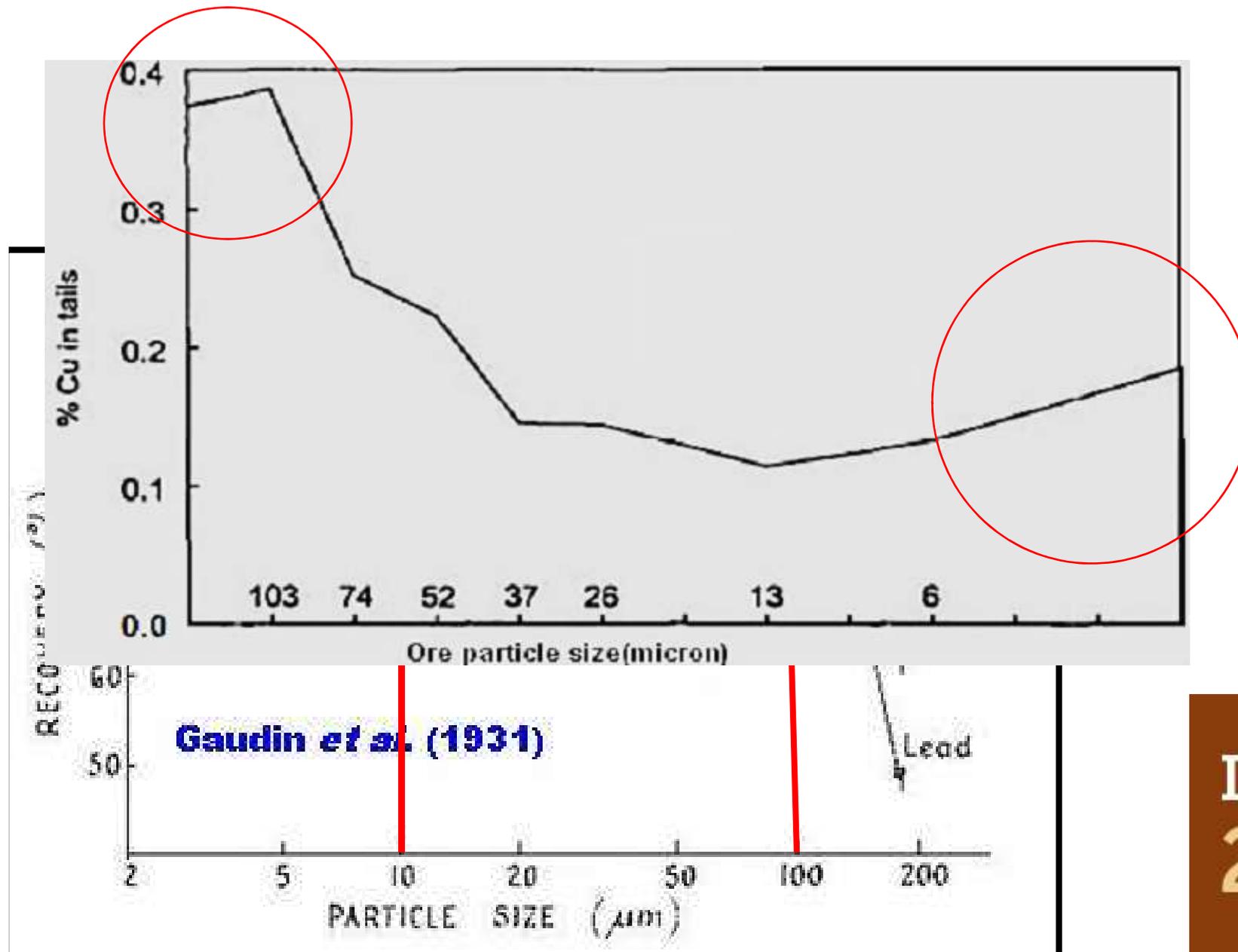
# 1905 or even 1885 Flotation machine



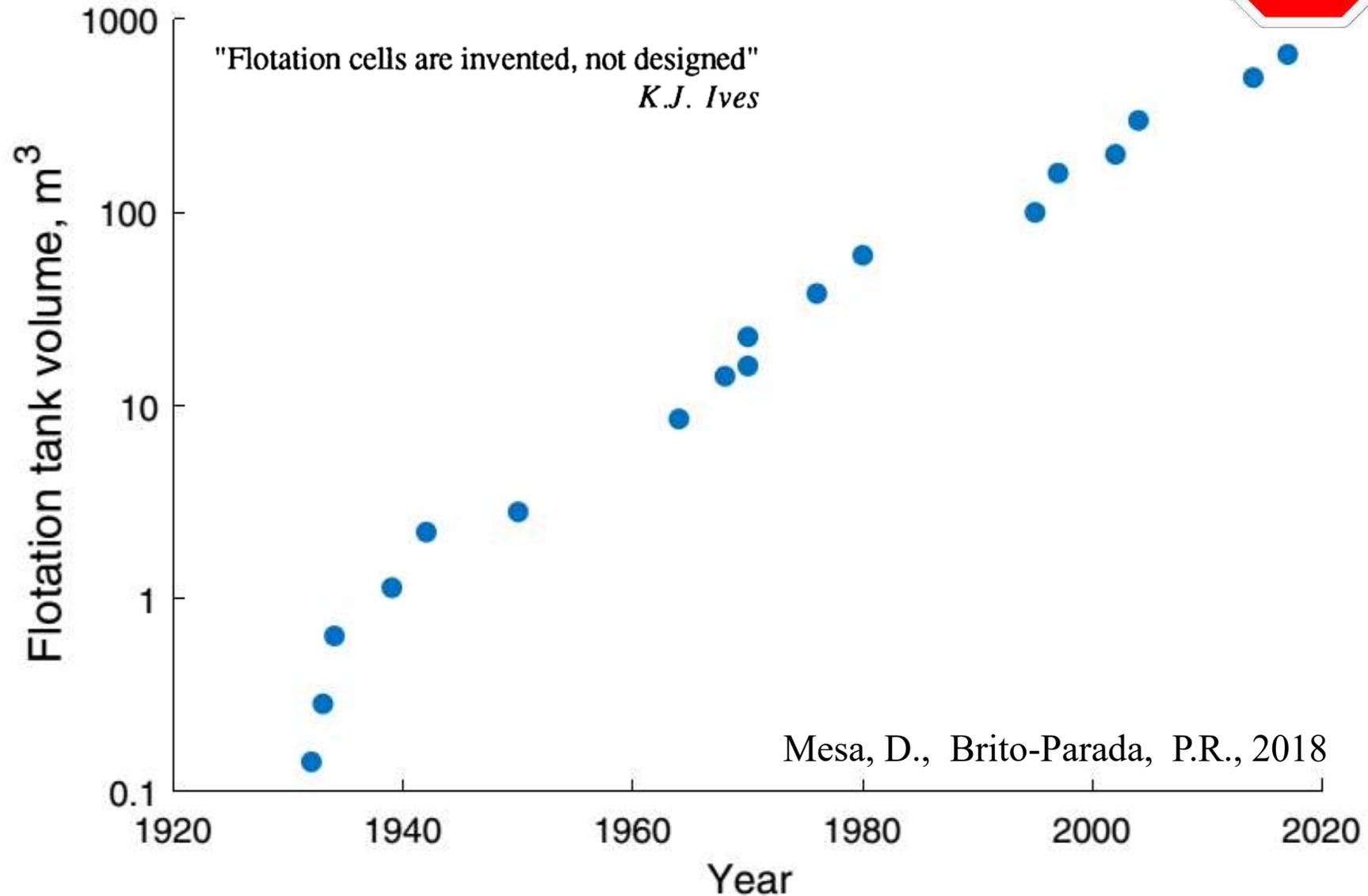
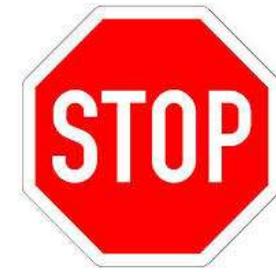
**VS.**



# What is the problem?



# What was the solution so far?



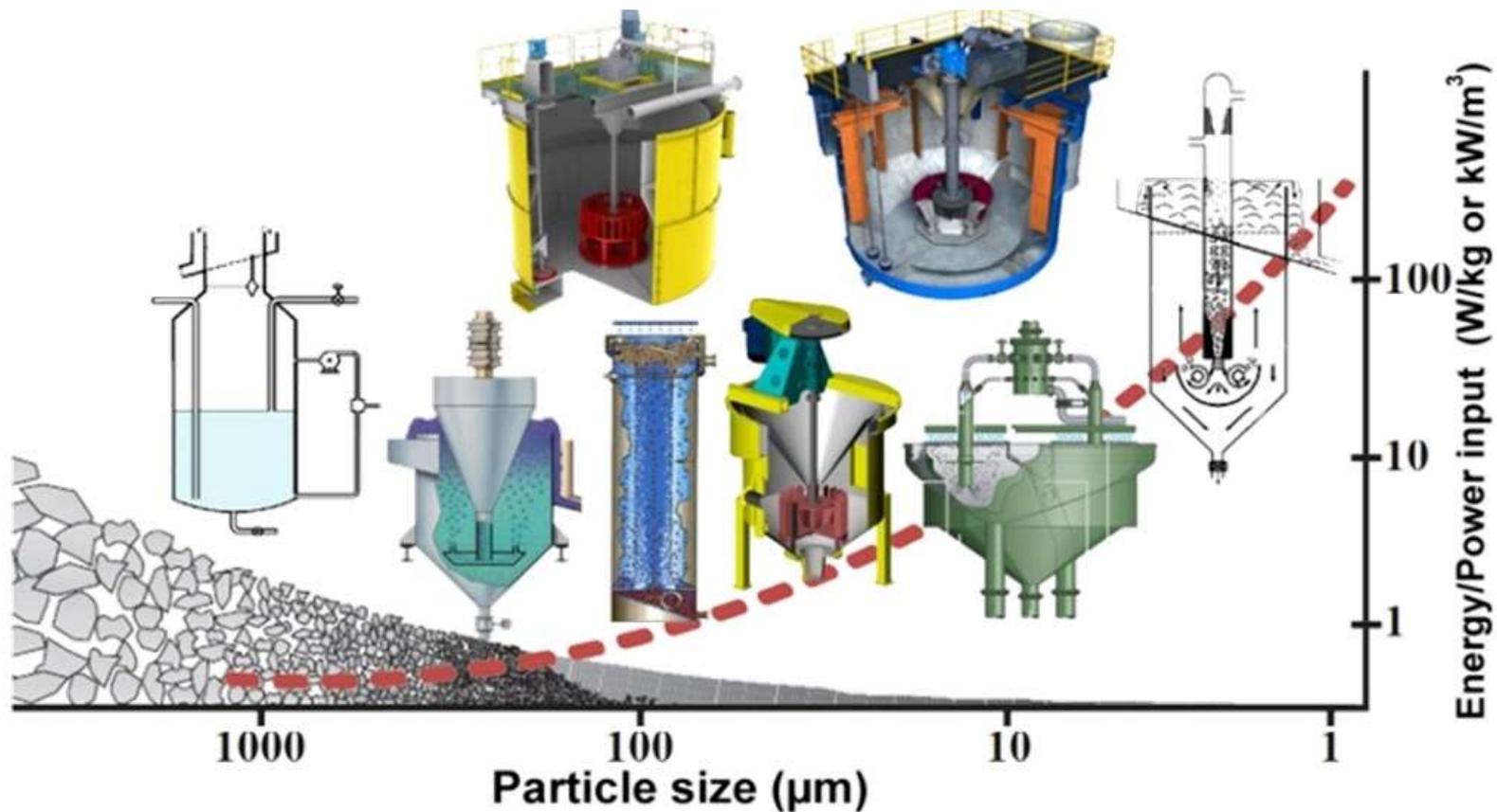
# Fine or coarse flotation?

Conventional mechanically agitated flotation cell

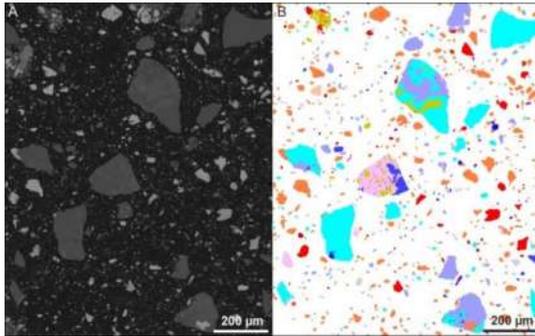
Flash, Concord™ and HydroFloat™

Jameson, RFC and Imhoflot™

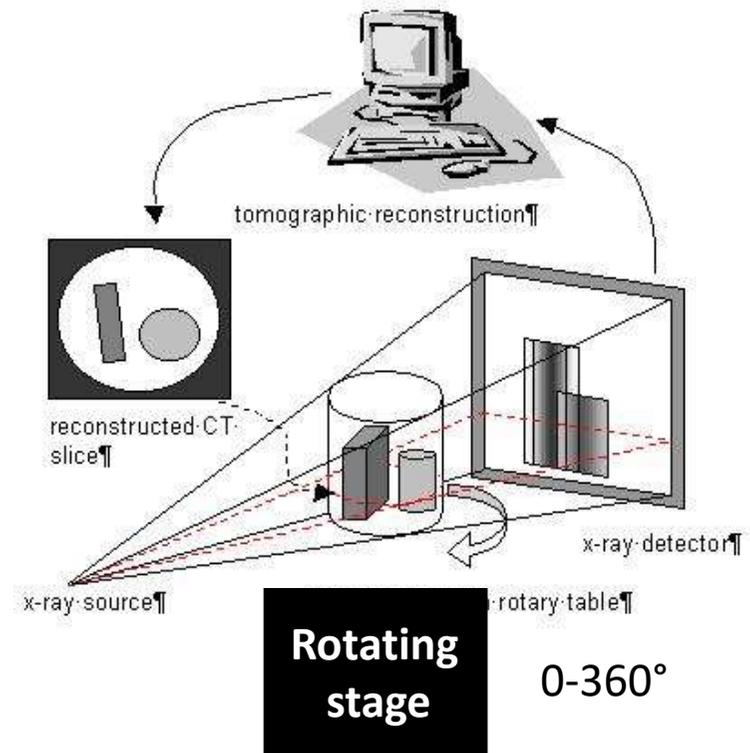
Electro-flotation  
Carrier flotation  
Reactive oily bubble



# Characterization issues? (MLA vs. XCT)

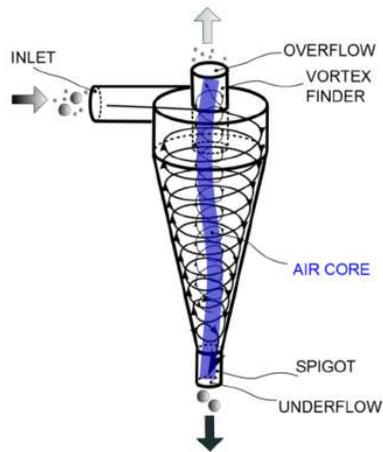


- Representativity shortcoming and sample preparation
- Stereological bias (2D) and number of analyzed particles
- Not applicable for coarse particles
- Agglomeration issue for fine particles



- Low resolution (tens of microns)
- Lack of chemical information
- Requirement for an electron density difference

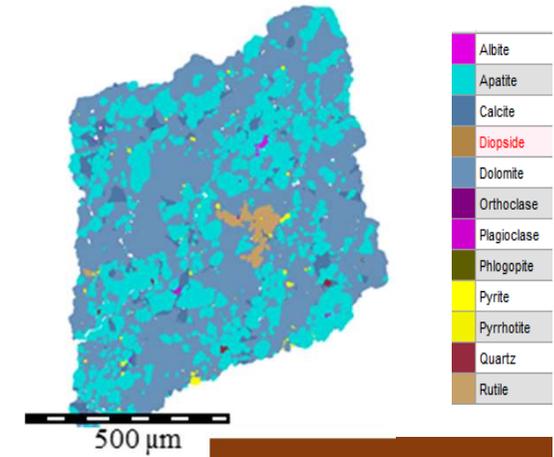
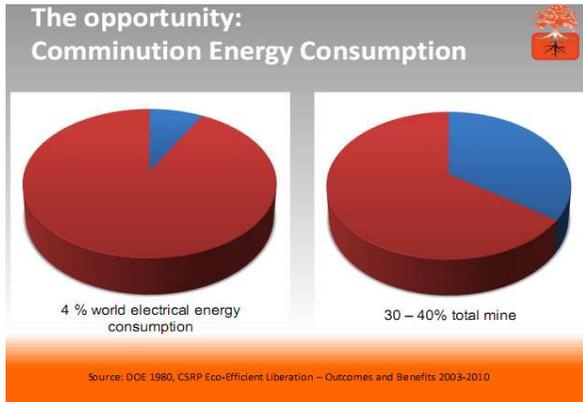
# Grinding and classification issues?



- Inefficiency of hydrocyclones and overgrinding in a closed circuit
- Low performance efficiency of screening and clogging issues

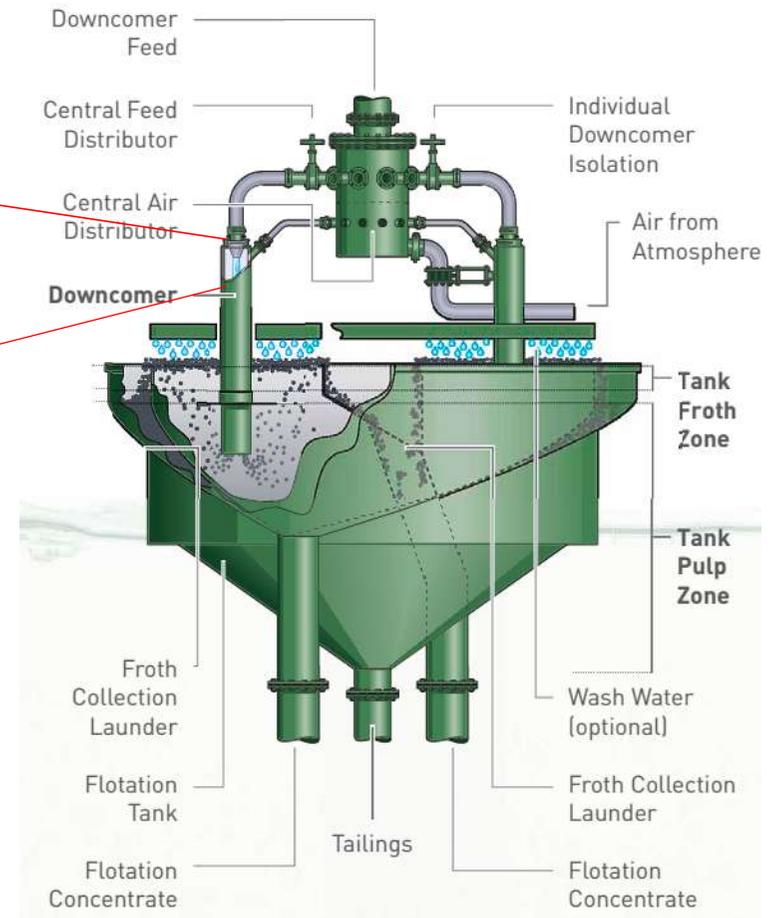
# Fine flotation

# Coarse flotation



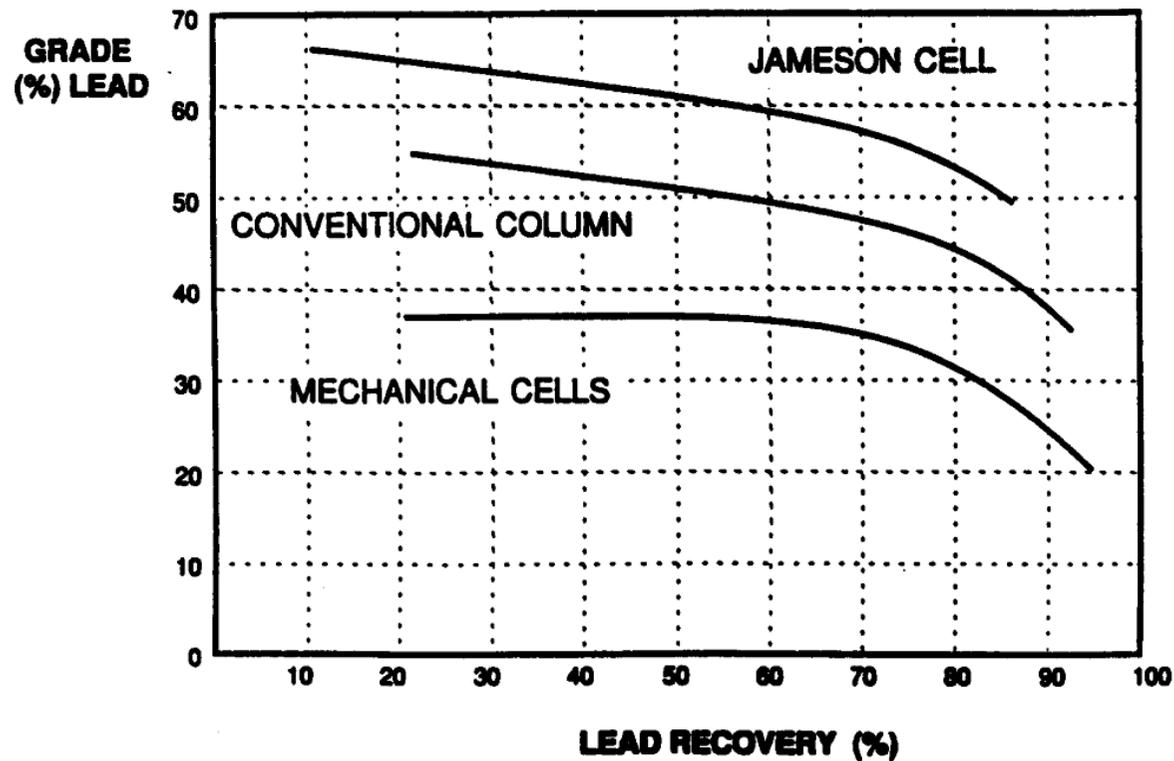
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# Fine flotation (Jameson and Imhoflot™)



# Advantages of pneumatic cells

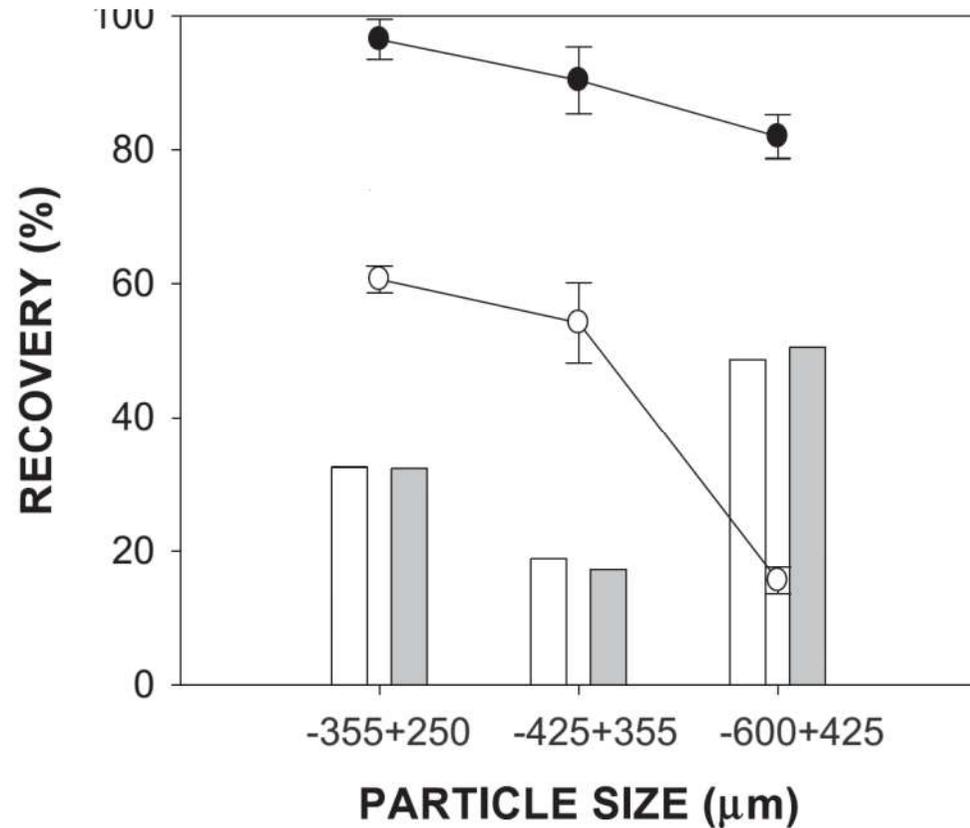
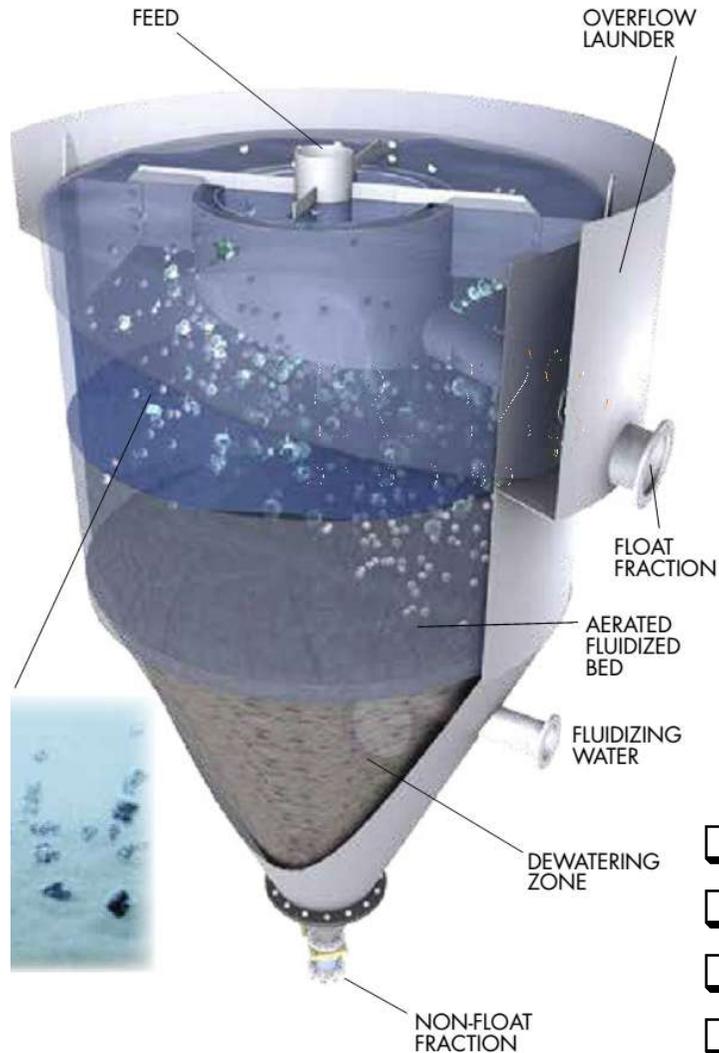
- ❑ Very short slurry residence time
- ❑ Relatively small bubble sizes
- ❑ Fast kinetic rate and froth washing ability (low entrainment)
- ❑ No agitation part leading to reduction of energy consumption
- ❑ Simple installation, coupled with high throughputs



Mount Isa slimes test results

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# Coarse flotation (HydroFloat™)



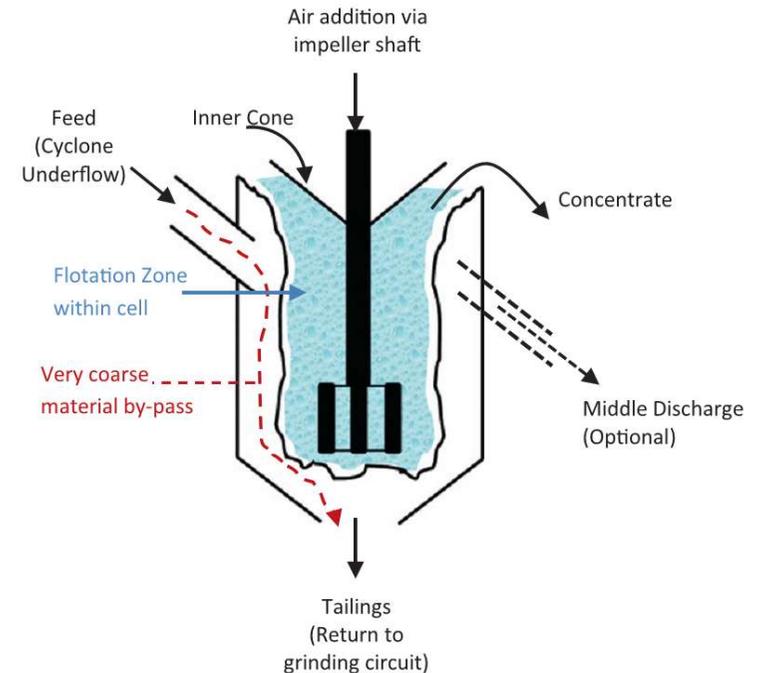
Fosu et al. 77(2015), Miner. Eng.

- Potash (Canada),
- Coal, vermiculite (U.S.A.)
- Spodumene (Australia)
- Diamonds (Canada)



# Coarse flotation (Flash: SkimAir®)

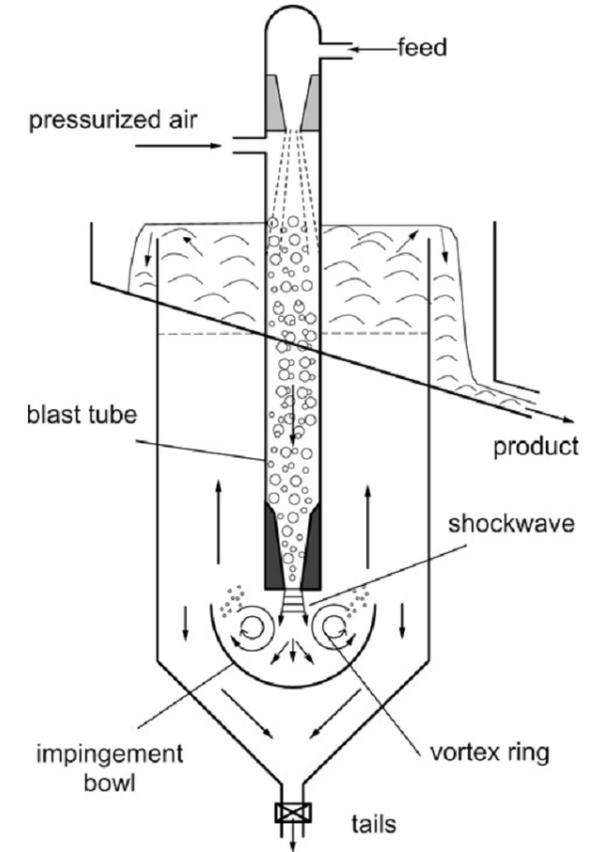
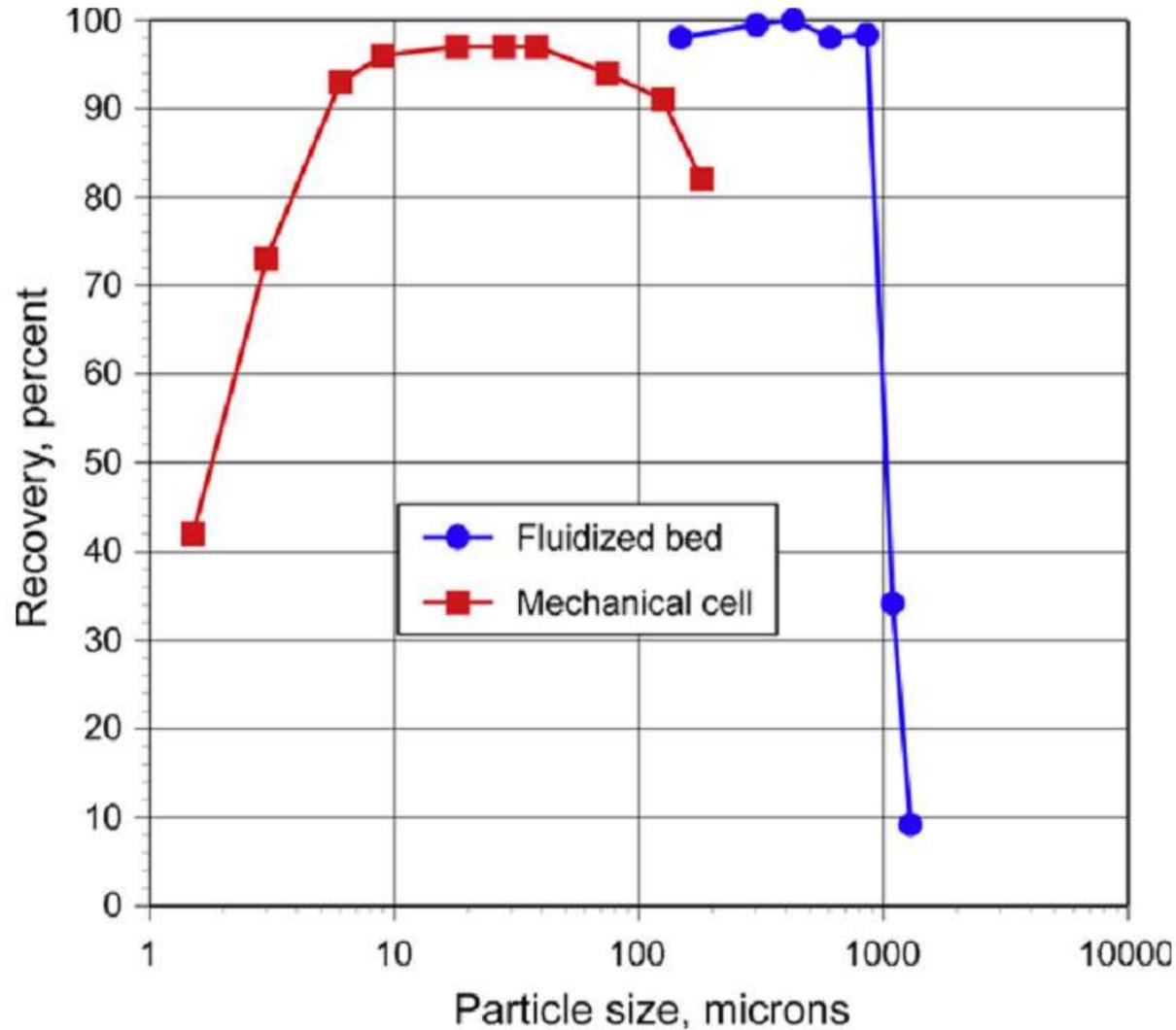
- ❑ Designed to avoid over-grinding of the valuable dense sulfide minerals in circulating load
- ❑ Minimizes over-grinding, enhances overall recovery, increases mill throughput and improves dewatering
- ❑ Processing complex ores containing coarse (-212+38  $\mu\text{m}$ ) or free gold
- ❑ Hydrocyclone underflow with high slurry % solids (up to 70%) is the flash flotation feed and its tailings recirculate into the grinding unit
- ❑ Minimal contact time of particles with reagents and almost no conditioning stage prior to the flotation



Newcombe et al., 2012, Miner, Eng.

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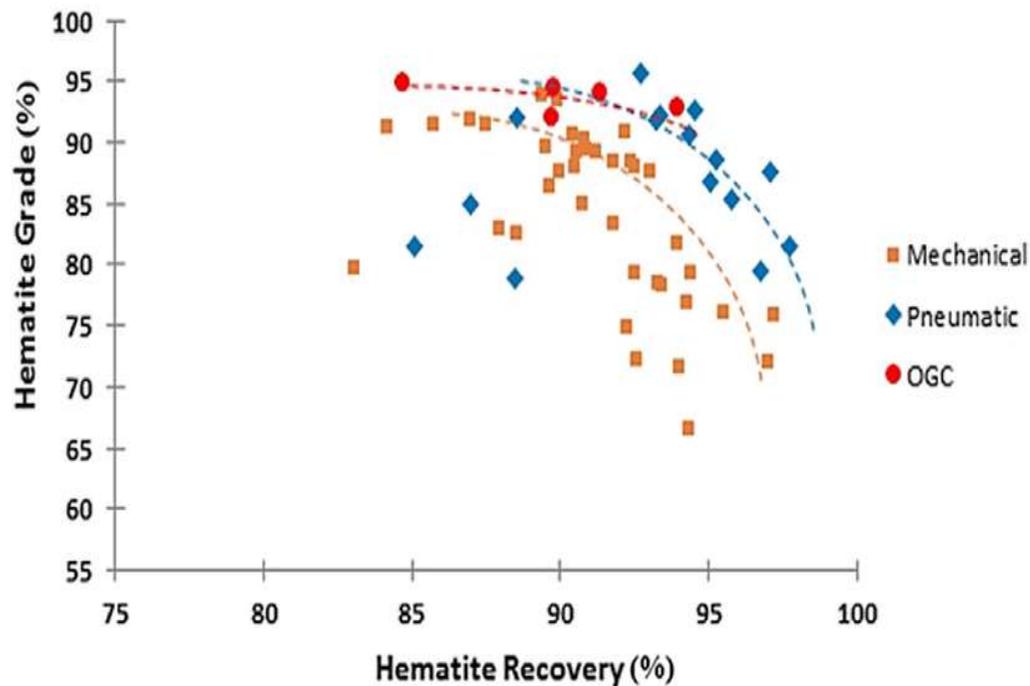
# Coarse flotation (Concorde Cell)



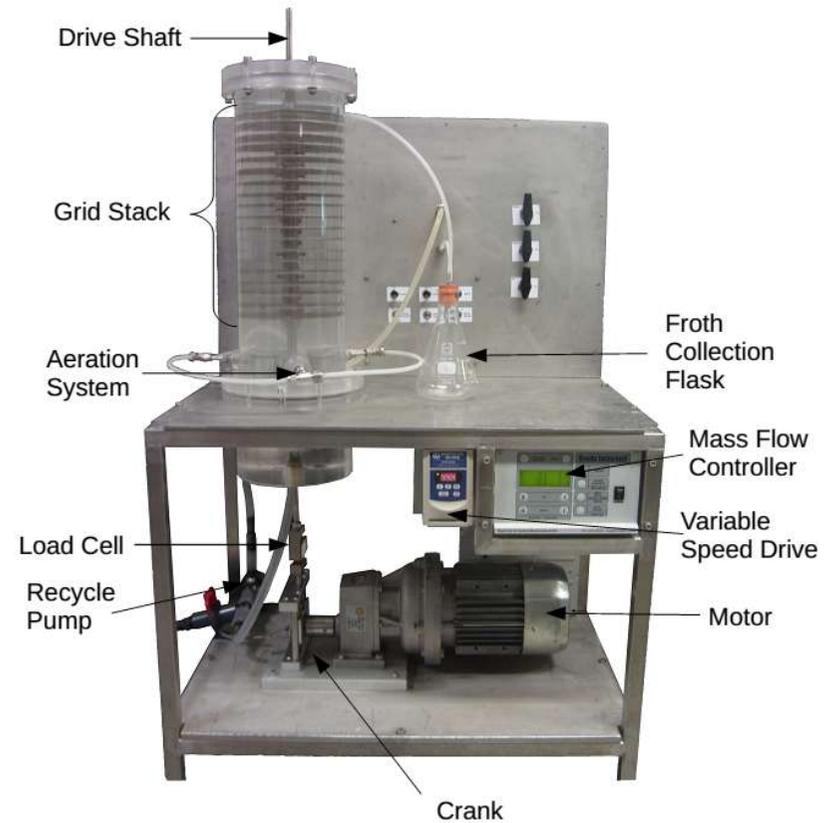
Jameson, 23 (2010), Miner. Eng.

# Fine and Coarse flotation (OGC)

- ❑ Relatively isotropic and homogeneous turbulence
- ❑ Variable energy dissipation rate (0.5– 5 kW/m<sup>3</sup>)
- ❑ Generate small bubble sizes (0.13- 0.83 mm)



Safari et al., 150, 2020



# Take away messages...

**Finally deciding with fine, coarse and fine-coarse particle treatments**

**Development of appropriate particle characterization utilities**

**Elaboration of milling and classification machineries**

**Replace pneumatic cells for treating tailing repositories**

**Lowering the gap between research and industry**

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Gràcies

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Спасиби

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Ngiyabonga  
Salamat sa iyo

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