



# HYDROFLOAT<sup>®</sup>

## Coarse Particle Flotation (CPF)



# ERIEZ





# ERIEZ HYDROFLOAT TECHNOLOGY - THE FIRST AND ONLY COMMERCIALY-PROVEN SOLUTION FOR COARSE PARTICLE FLOTATION WITH MORE THAN 70 UNITS INSTALLED WORLDWIDE

**2018**

First HydroFloat CPF circuit in copper sulfide application

**2004 - 2018**

Growth of the HydroFloat CPF technology in industrial mineral applications

**2004**

First HydroFloat CPF circuit in operation (potash)

**2002**

HydroFloat Patent granted

**1997**

HydroFloat CPF testing initiated in the Phosphate and Potash industries

*HydroFloat CPF circuit for tailings scavenging at Newcrest Cadia Valley copper-gold mine.*

# HYDROFLOAT® COARSE PARTICLE RECOVERY

The **HydroFloat®** is an aerated fluidized-bed separator that combines the benefits of density separation with the selectivity of flotation.

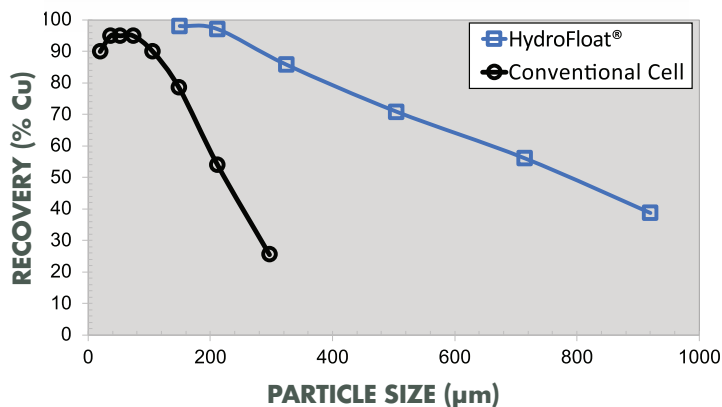
In operation, feed slurry is introduced at the top of the HydroFloat and descends against a rising mixture of water and fine air bubbles to form a fluidized bed of solids. Air bubbles selectively attach to hydrophobic particle surfaces to reduce the effective density of bubble-particle agglomerates, which reduces settling velocity and facilitates hydraulic carryover to the overflow. Expansion of the fluidized bed is controlled to alter the effective bed density, thus preventing lower density agglomerates containing the target mineral species from penetrating the fluidized bed and reporting to the underflow.

The result of this breakthrough technology is an order of magnitude increase in selective recovery of coarse particles (e.g. +150µm) with as little as between 1% to 10% mineral surface expression, as well as a corresponding shift in the economic optimum grind size for concentrators.



## HydroFloat Technology Advantages:

- Increased probability of bubble/particle collision
- Increased residence time
- Decreased axial mixing
- Increased bubble/particle contact time after collision
- Decreased turbulence and probability of detachment
- No froth layer or associated froth recovery challenges
- Fluidization water evacuates bubble-particle agglomerates into concentrate launder



**85% increase in water recovery**

**10% to 20% decrease in energy consumption**

**Facilitates dewatering and disposal of dry tailings**

**10% to 35% increase in processing capacity**

**2% to 6% increase in global recovery**

◀ Recovery by particle size for a copper sulfide ore; comparison of HydroFloat with a conventional flotation cell. The blue curve shows the opportunity to improve recovery and coarsen concentrator grind size using the HydroFloat technology.





**FEED**

**OVERFLOW LAUNDER**

**FLUIDIZED BED**

**CONCENTRATE**

**DEWATERING CONE**



**FLUIDIZATION WATER/AIR MIXTURE**

**TAILINGS**

## HYDROFLOAT FEATURES

### Solids Loading

15 to 20 t/h-m<sup>2</sup>.

### Flotation Air

< 0.5 cm/s.

### Fluidization Water

Consumption varies with ore particle size distribution and specific gravity. Most water is recovered easily in downstream dewatering process due to high sedimentation rate of coarse particles.

### Feed Particle Size

The HydroFloat is used commercially for flotation of particles up to 4 mm (potash). For copper sulfide applications, typical feed size range is 600µm or 800µm x 150µm, depending on the liberation characteristics of the ore.

### Feed Preparation

HydroFloat feed generally requires pre-classification to optimize performance due to the effect of particle size on solids settling rate.

### Solid Content

The weight percent solids in the HydroFloat feed typically ranges from 55% to 70%. The tailings produced from the cell have a similar weight percent solids as the feed (>60%).

### Liberation

3D Tomography and MLA studies have proven that the HydroFloat can recover target mineral species with as low as 1% to 10% hydrophobic surface expression (Miller et. al, 2016, Mehrfert 2017).

### Plug Flow

The HydroFloat cell behaves like a plug flow reactor. This allows flotation to occur in a single stage. The tailings produced in this cell are final tailings.

### Reagents

The HydroFloat technology works with similar reagents as used in conventional flotation processes.

### Reliability and Maintenance

With no internal rotating or moving parts, the HydroFloat has exceptional operational availability and low maintenance cost. Unplanned downtime due to mechanical failures and abrasive wear of internal components are greatly reduced as compared to conventional flotation cells.

## Proven HydroFloat® Applications

To date, more than 70 HydroFloat units have been installed in:

- **Copper (Cu/Mo, Cu/Au)**
- **Gold**
- **Iron Ore**
- **Polymetallic Ores (Pb/Zn/Cu)**
- **PGM**
- **Phosphate**
- **Potash**
- **Lithium**
- **Coal**









## CIRCUIT DESIGN & SIZING

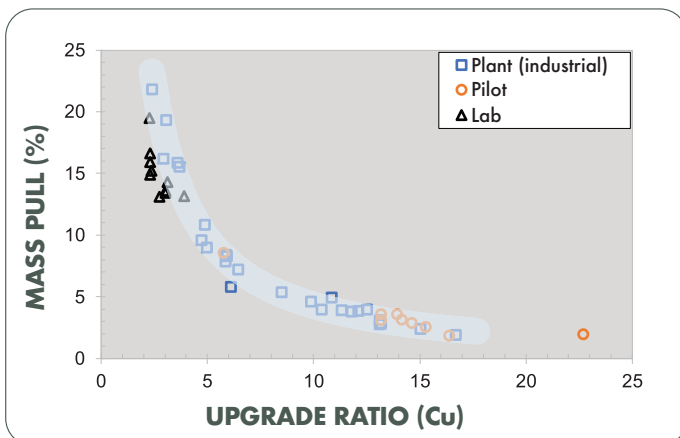
With more than 20 years of coarse particle flotation knowledge and experience, Eriez' highly qualified team of metallurgists can identify and evaluate the most effective options to integrate the HydroFloat® CPF process into brownfield and greenfield projects. Utilizing industry-proven test equipment and procedures, specification and sizing of HydroFloat equipment is simple and sure.



▲ Locations where HydroFloat CPF technology has been evaluated for base mineral flotation.

## METALLURGICAL SCALE-UP

HydroFloat metallurgical performance is accurately predicted using laboratory-scale and pilot-scale HydroFloat equipment. The laboratory-scale HydroFloat equipment facilitates steady-state continuous testing, the results from which are routinely used to size industrial equipment and provide process guarantees. In-plant pilot testing can also be performed to demonstrate the HydroFloat technology at a larger scale and to confirm metallurgical performance over a range of feed characteristics.



▲ Upgrade ratio vs. mass pull for the different scales of HydroFloat equipment evaluated in a Cu/Mo Plant.



▲ HydroFloat CPF circuit for tailings scavenging at a Cu/Mo Plant.

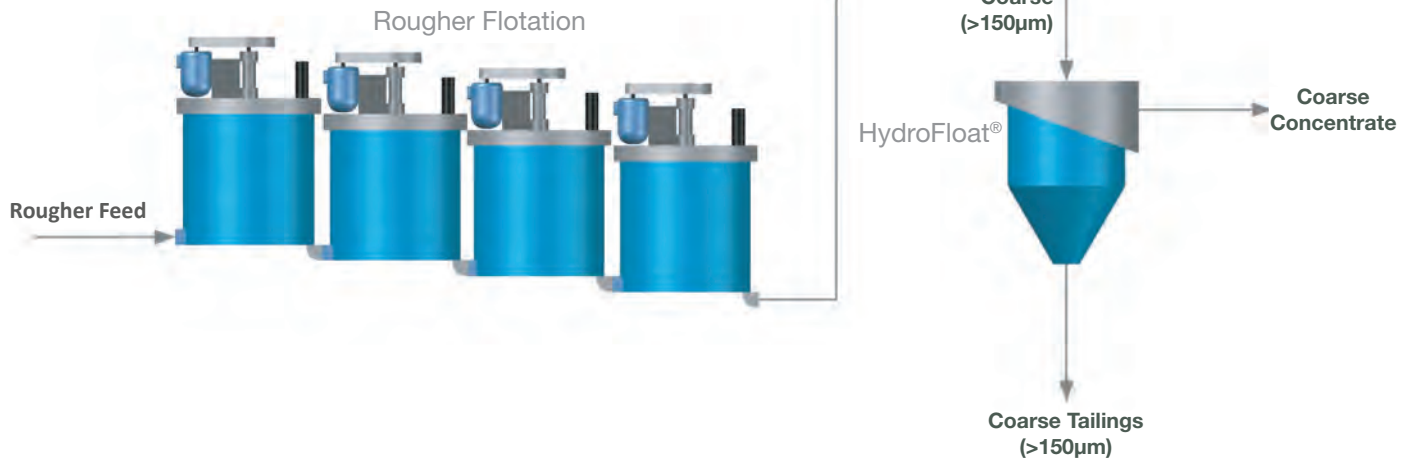






# APPLICATION 1: TAILINGS RECOVERY

## HydroFloat® Tailings Scavenger (TS) Circuit Flowsheet



## HydroFloat® Tailings Scavenger Benefits

### Increase Recovery

HydroFloat TS provides selective recovery of semi-liberated and fully-liberated minerals contained within the coarse size fraction of rougher flotation tailings, thus increasing global plant recovery. For example, HydroFloat TS has been demonstrated to increase global recovery of copper concentrators by 2% to 6%.

### Simple Implementation

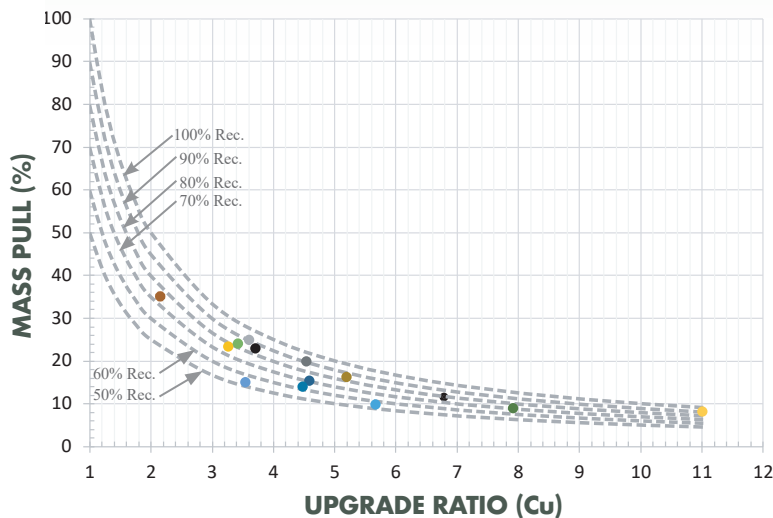
Construction of a HydroFloat TS circuit does not interfere with operation of the conventional plant. Therefore, construction can advance without impacting plant production and the tie-in can be made during a planned maintenance shutdown.

### Increase Profitability

Additional concentrate produced from the HydroFloat TS process has lower OPEX compared to concentrate produced by the conventional plant as the mining, transport, and primary comminution costs are already incurred. Therefore, this additional production improves the aggregate profitability of the concentrator.

### Increase Production

The increased recovery of coarse particles by HydroFloat TS allows for an increase in mill throughput without a reduction in global recovery. The corresponding increase in flotation feed P<sub>80</sub> results in a reduction in rougher flotation recovery, which is offset by the additional recovery of the HydroFloat TS process.



◀ Cu Upgrade Ratio vs. Mass Pull, HydroFloat TS results for various copper mine tailings.

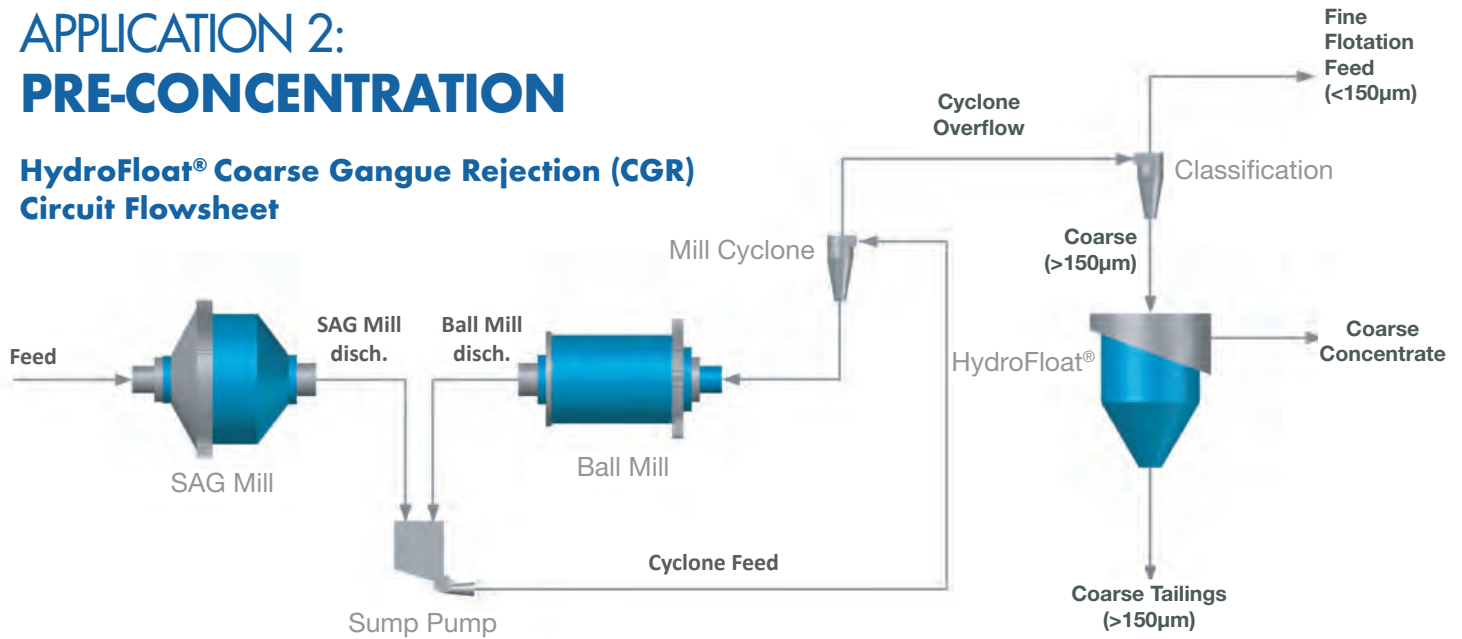






# APPLICATION 2: PRE-CONCENTRATION

## HydroFloat® Coarse Gangue Rejection (CGR) Circuit Flowsheet



## HydroFloat® Coarse Gangue Rejection Benefits:

### Reduce Energy Consumption

Increase ball mill grind size ( $P_{80}$ ) to  $350\mu\text{m}$  to  $500\mu\text{m}$  without affecting global recovery, resulting in 30% to 50% energy savings in the ball mill circuit.

### Reduce Conventional Flotation Plant Footprint

30% to 40% of the gangue will be removed from the process through the HydroFloat tailings. Consequently, the conventional flotation plant size will be 30% to 40% smaller.

### Improve Disposal of Tailings

HydroFloat CGR tailings have a  $P_{80}$  of  $400\mu\text{m}$  to  $600\mu\text{m}$ , which corresponds to a substantial increase in hydraulic conductivity over conventional process tailings. This improves the economics of tailings dewatering and facilitates dry disposal at reduced environmental risk. HydroFloat CGR tailings represent 30% to 45% of the total concentrator tailings.

### Increase Recovery

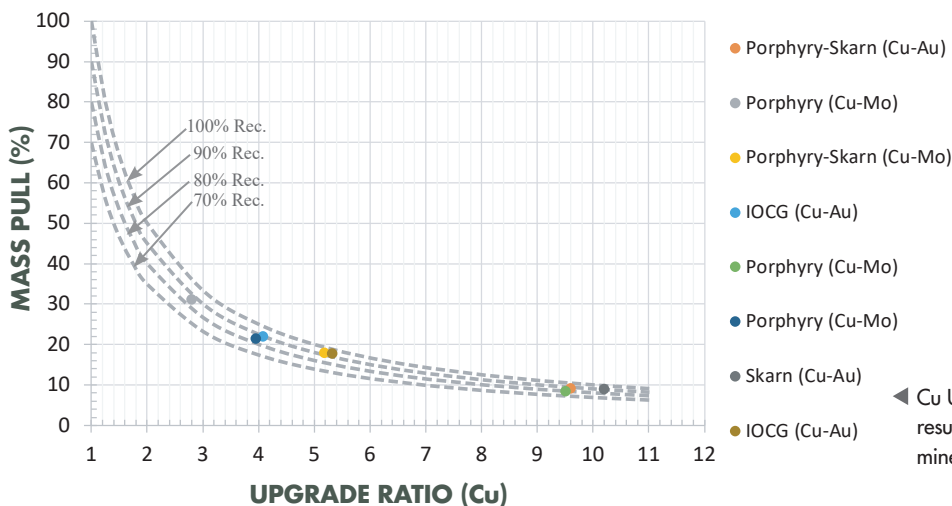
In addition to recovering coarse particles, HydroFloat CGR circuits facilitate a reduction in overgrinding which results in increased recovery in the conventional rougher circuit.

### Increase Production

For brownfield expansion projects, a HydroFloat CGR circuit facilitates a simultaneous increase in mill  $P_{80}$  and increase in mill capacity by 10% to 35% without any reduction in global recovery.

### Reduce Water Consumption

With the HydroFloat CGR process, 30% to 55% of the plant throughput is processed in coarse fractions ( $>150\mu\text{m}$ ), which simplifies solid-liquid separation and improves water recovery. It is estimated that implementation of the HydroFloat CGR process in combination with advanced dewatering processes can improve water recovery by 85%.



◀ Cu Upgrade Ratio vs. Mass Pull, HydroFloat CGR results on run-of-mine ore from various copper mines. HydroFloat feed  $P_{80}$  was  $450\mu\text{m}$  -  $550\mu\text{m}$ .



## ERIEZ FLOTATION – GLOBAL LEADER IN ADVANCED FLOTATION TECHNOLOGIES

Eriez Flotation is focused on driving the adoption of sustainable flotation technology through innovation and strong customer partnerships.

Eriez Flotation is committed to providing state-of-the-art equipment and process solutions for new and existing projects worldwide. We understand and quickly respond to the needs of our clients. Our versatility is demonstrated by the diversity of our engineering services and the varying sizes of projects we have successfully completed around the world.

Our state-of-the-art metallurgical and analytical laboratory facilities are available to demonstrate our technology and pilot solutions based on your unique needs.

Contact your local Eriez Flotation representative for expert support and innovative solutions customized for your application.



**Eriez** Flotation | Canada  
7168 Venture St  
Delta, BC, V4G 1H6  
Canada  
Office: +1 604-952-2300  
efdca@eriez.com

**Eriez** Flotation | Brazil  
Av. Getúlio Vargas, no 456 - 120 andar  
Funcionários – Belo Horizonte - MG  
Brazil  
Office: +55 31 3281 9108  
efdbr@eriez.com

**Eriez** Flotation | Chile  
Badajoz, 130 Of. 1505  
Las Condes, Santiago  
Chile  
Office: +56 2 29523400  
efdcl@eriez.com

**Eriez** Flotation | Perú  
Av. Circunvalación del  
Club Golf Los Incas 134,  
T-1, Oficina 806,  
Surco, Lima  
Perú  
Office: +51 1 719 4150  
efdpe@eriez.com

**Eriez** Flotation | USA  
1901 Wager Road  
Erie, PA 16509  
USA  
Office: (814) 835-6000  
efdusa@eriez.com

**Eriez** Flotation | China  
Workshop C2, No.10,  
Xeda North 1st Road,  
Xiqing Economic Development Area,  
Tianjin, 300380, China  
Office: +86 22 83904608 Ext. 136  
efdcn@eriez.com

**Eriez** Flotation | Australia  
21 Shirley Way,  
Epping, Victoria 3076  
Australia  
Office: +61 (03) 8401 7400  
efdau@eriez.com

**Eriez** Flotation | Mexico  
Hacienda La Pila 104,  
Hacienda de Bravo  
San Luis Potosi, SLP. 78175  
Mexico  
Office: +52 444 212 0067  
olopez@eriez.com

**Eriez** Flotation | South Africa  
30 Innes Road (cnr Graniet Rd),  
Jet Park Ext. 66  
Boksburg, Gauteng  
South Africa  
Office: +27 011 444 9160  
efdafrica@eriez.com

[www.eriezflotation.com](http://www.eriezflotation.com)



# ERIEZ

Eriez Flotation is a global leader in mineral flotation technology providing innovative equipment and processes that address environmental and sustainability challenges facing the mining industry. The company provides various flotation equipment for the mining and minerals processing industries, including fluidized-bed flotation, high-intensity mechanical flotation, and column flotation technologies, as well as advanced testing and engineering services. Eriez, HydroFloat, CrossFlow, SlamJet and StackCell are registered trademarks of Eriez Manufacturing Co.