Extended Abstract: Jameson Cells in Industrial Rougher Applications

Introduction

As global demand for mineral resources intensifies and operational constraints tighten, flotation technologies must evolve to meet the dual challenge of metallurgical excellence and plant efficiency. The Jameson Cell, long recognized for its high-intensity flotation kinetics and compact footprint, is increasingly being deployed in rougher flotation duties, which is a shift that marks a significant evolution in its industrial application. This paper explores the strategic deployment of Jameson Cells in rougher and rougher-scalping roles, focusing on recent design enhancements, operational outcomes, and the broader implications for concentrator performance and circuit design.

Background and Technological Evolution

Originally developed in the 1980s through collaboration between Mount Isa Mines and the University of Newcastle, the Jameson Cell introduced a paradigm shift in flotation technology. Unlike conventional mechanical cells that rely on impellers and large tanks, the Jameson Cell uses a downcomer to create a high-shear environment where air and slurry interact rapidly. This design enables fast flotation kinetics, fine bubble generation (~0.5 mm), and efficient particle-bubble attachment. All without external blowers or agitators.

Historically favoured in cleaner applications, the Jameson Cell's transition into rougher and scavenger duties has been catalysed by key design advancements. Chief among these is the introduction of a 500 mm downcomer cells, which significantly increases single-cell capacity while maintaining metallurgical scale-up integrity. This innovation has enabled Jameson Cells to treat up to 4500 tph, positioning them as viable alternatives to multi-stage mechanical rougher scavenger flotation trains.

Operating Principles and Performance Advantages

The Jameson Cell's operating principal centres on a slurry jet that induces air into the downcomer by venturi effect, creating a turbulent mixing zone. This zone facilitates rapid particle-bubble interaction, followed by separation in the tank where hydrophobic particles rise to form froth and hydrophilic gangue exits to tailings. Froth washing systems further enhance concentrate purity by minimizing entrainment.

Key performance advantages in rougher applications include:

- **High throughput with reduced footprint**: Jameson Cells achieve comparable feed volumes to the largest mechanical cells with significantly smaller tank volumes and number of units.

- **Simplified circuit design**: A two-cell configuration (rougher-scalper and scavenger) can replace traditional five to eight cell mechanical trains.
- **Scalping capability**: The ability to produce final concentrate grade material in a single stage reduces downstream complexity and enables debottlenecking.

Testwork and Scale-Up Validation

Glencore Technology's standard laboratory dilution tests and pilot rigs (L150 and Z500) have consistently demonstrated 1:1 grade/recovery scale-up from bench to industrial scale. This reliability has underpinned the successful deployment of Jameson Cells in both brownfield and greenfield projects, as evidenced by three recent case studies.

Case Study 1: Lundin Gold – Fruta del Norte, Ecuador

Fruta del Norte (FDN), an underground gold mine in Ecuador, sought to increase flotation circuit throughput while maintaining high recovery and concentrate grade. Initial laboratory and Z500 pilot tests confirmed the suitability of Jameson Cells, leading to the installation of three industrial units, including 2 B5400/18 units; one in rougher-scalper duty, at the head of the circuit, and the second as a scavenger on the end of the current rougher-scavenger train.

Key outcomes:

- Gold recovery increased by 3.3%, from 87.1% to 90.4%
- Final concentrate grade rose to 199 g/t gold
- Recovery of -20 micron particles improved, reducing fine particle tailings losses by 13.1%
- Sulphur recovery increased by 8.2%, lowering sulphur grade in CIL feed and reducing cyanide consumption from 54 ppm to 37 ppm

These results demonstrate not only metallurgical improvement but also downstream cost savings and reagent efficiency. The full-scale cell outperformed pilot trials in both grade and recovery expectations in 60% of commissioning surveys, reinforcing the robustness of Jameson Cell scale-up and the ability to improve further with fine-tuning in operation.

Case Study 2: Ero Copper – Caraíba, Brazil

At the Caraíba operation in Bahia, Brazil, Ero Copper aimed to debottleneck its concentrator by scalping a final copper product using a Jameson Cell. Laboratory dilution tests and Z500 pilot trials validated the concept, leading to the installation of a B6500/24 in rougher-scalper duty.

Key outcomes:

- Copper recoveries ranged from 67% to 81% in a single unit Jameson Cell scalper
- Concentrate grades reached up to 43% Cu, above the 36% final concentrate grade target
- Feed throughput increased by 50%, from 400 tph to 600 tph

Operating at 35–45% solids with a chalcopyrite/bornite feed and F80 between 80–110 microns, the Jameson Cell delivered consistent performance that aligned with pilot and lab data. The installation enabled significant throughput gains without expanding plant footprint, a critical advantage in constrained brownfield environments.

Case Study 3: Northern Star – Pogo Gold, Alaska

Northern Star's Pogo Gold mine in Alaska faced a flotation bottleneck while scaling production from 5.7 to 8.5 tonnes of gold annually. With limited space in the flotation building, conventional expansion was unfeasible. A Jameson Cell was proposed for rougher-scalping duty at the circuit head.

Key outcomes:

- Bench-scale tests achieved 91% recovery at a concentrate grade of 47 g/t gold, exceeding the 70% recovery and 40 g/t targets
- Flotation throughput increased by over 60%, reaching 5000 tpd

Despite the absence of pilot-scale testing due to time constraints, bench-scale results provided sufficient confidence for full-scale deployment. The success at Pogo underscores the Jameson Cell's ability to significantly debottleneck flotation circuits even in space-limited scenarios.

Strategic Implications for Industry

The deployment of Jameson Cells in rougher applications represents a strategic shift in flotation circuit design. Key implications include:

- **Debottlenecking without expansion**: Jameson Cells offer a compact solution for increasing throughput in constrained plants.
- **Greenfield efficiency**: Reduced equipment requirements and simplified flowsheets with lower capital costs and operational complexity.
- **Improved recovery and grade**: High-intensity flotation kinetics enable superior metallurgical performance, especially for fine and liberated particles.
- **Sustainability gains**: Low carbon footprint equipment contributing to environmental and economic sustainability.

These advantages align with broader industry trends toward small footprint, high-performance technologies that support flexible, scalable operations.

Conclusion

The Jameson Cell is firmly establishing its role in industrial rougher applications, delivering measurable advancements in throughput, recovery, and circuit simplicity. Recent design enhancements to the cell, particularly the larger downcomer models, have expanded its capacity and applicability, enabling it to compete directly with conventional mechanical cells in high-tonnage duties.

Case studies at Fruta del Norte, Caraíba, and Pogo Gold illustrate the technology's versatility across commodities, geographies, and operational contexts. Whether addressing brownfield bottlenecks or optimizing greenfield designs, the Jameson Cell offers a proven, scalable, and high-performance flotation solution.

As concentrators seek to balance metallurgical excellence with operational efficiency, the Jameson Cell stands out as a transformative technology; compact, effective, and ready for the demands of modern mining.