Why Jameson Cell Could Be About To Boom in South America

Copper processing in South America has a lot to gain from the adoption of technologies that improve concentrate grades and recoveries.

Add to this the continuing depletion of the world's mineral resources and a recognised deficit in concentrates and there's great pressure on the efficiency of modern operations in general, on concentrators and on flotation circuits.

Jameson Cell flotation technology is looming as a key contributor to improved flotation circuits, with recent case-studies suggesting significant improvements to copper recoveries.

After 350 installations around the world, Glencore Technology's Jameson Cell is gaining renewed interest in Central and South American copper operations, with Collahuasi and Cobre Panama taking them on within the year.

The Operating Principles of Jameson Cell

Jameson Cell Technology Manager, Virginia Lawson, says the Jameson Cell has sometimes incorrectly been regarded as a type of column cell. The Jameson Cell operates on completely different principles.

"Both use froth washing to control entrainment, but where column cells use spargers, standard bubbles and long residence time, the Jameson Cell is a reactor/ separator technology that uses high-intensity mixing to increase particle collision and attachment", says Lawson.

The Jameson Cell uses a series of very high-intensity downcomers to deliver feed into the cell through a high-pressure jet. This jet shears and entrains air and creates very small bubbles, which collide with the particles in the slurry. With more surface-area created by smaller bubbles, a greater net particle attachment occurs, creating high cell carrying capacities.

"The result is more concentrates from a smaller circuit in far less residence time. In fact, residence time is not a contributor to performance, so the Jameson Cell has been shown to deliver more concentrate per unit of space, per unit of time and per dollar invested in assets."

The high flotation rates are a distinguishing feature of Jameson Cells, since they consistently provide very small bubble sizes. This is important for the cleaning of finer streams, which are becoming more prevalent as ores become more complex and need finer regrinding for mineral liberation.

Glencore Technologies new cleaner circuit flowsheet operates with at least two Jameson Cells in critical roles producing high grade final concentrate. The cleaner scalper recovers the highly liberated fast floating increment from the cleaner feed direct to final concentrate. This stage can operate at recoveries of up to 90% leaving very little work for the remainder of the circuit. The recleaner cell is operated in closed circuit with a cleaner scavenger which is only responsible for

producing a low tailings grade. The recleaner Jameson cell then upgrades the cleaner scavenger concentrate to final concentrate quality. The grade of the recleaner will be an indication of the liberation of the circuit as the remainder of the recovered particles are the slower floating fines and composites. Figure 1 shows the grade recovery curves for each of the Jameson stages…

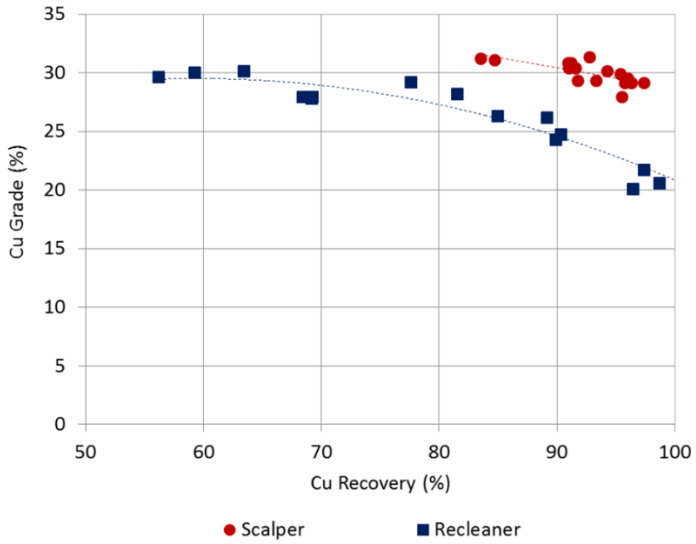

Figure 1. Recovery curves of the Jameson Cell

Recent papers based on surveys conducted on a Cleaner Scalper and a Recleaner Jameson Cell during commissioning showed strong results in copper processing. The Cleaner Scalper cell produced the highest grade concentrate across the flotation circuit. The recovery in the Cleaner Scalper was high thanks to the very large quantity of fast floating copper mineral particles in the feed and the high liberation levels.

The Recleaner Cell recovered a lot more composite particles and was evidenced by a different copper selectivity response with silica compared to the cleaner scalper cell.

Cleaner scavenger tailings were also collected to allow calculation of recovery across the entire cleaner circuit. Eight surveys over two days showed the overall cleaner circuit recovery to be over 98 per cent while producing a final plant concentrate grade averaging 29.5 per cent Cu. The overall plant recovery was maintained above the target of 96 per cent.

The new cleaner circuit design saw obvious benefits in metallurgical performance. But there were other tangible gains, too –

- The number of cells installed – fewer cells meant lower installation costs, and less ongoing operating, maintenance and spare parts costs
- Circuit total residence time – shorter residence time made for a more robust and responsive circuit that is faster to 'tune' and optimise
- Asset footprint – a smaller footprint had obvious advantages in foundation and structures, building and installation costs
- Installed motor power – ongoing savings in energy usage and cost.

How the Jameson Cell Evolved

The Mark 1 Jameson Cell was a world pioneer in concept and effectiveness. It eclipsed conventional flotation cells but it had small downcomers, no wash water, no tailings recycle and no bubble dispersers.

The Mark 2 improved all of these features. "Metallurgically, its performance was rock solid, and a circuit at Alumbrera back in 1996 performed brilliantly in both concentrate grades and recoveries. The Mark 2 design, however, was not easy to operate or maintain" says Lawson.

It's the 18 years since 2000 that has seen the biggest improvements. "The Mark 3 was designed with operations in mind, and was easier to operate and maintain. Slurry flow per downcomer was increased and a new slurry lens was developed to reduce maintenance downtime.

"And the Mark 4 in 2009 introduced flexible hoses, quick release clamps and incremental design improvements. These changes made the Jameson Cell the most effective and easy to operate flotation system. An individual downcomer can be checked and maintained without taking the Cell offline."

Accurate Scale Up and Risk Mitigation

The Jameson Cell was shown to scale up remarkably accurately from laboratory flotation tests and directly from pilot scale rigs. For greenfield sites where large scale piloting is not a practical, a procedure to accurately simulate the Jameson Cell performance was developed and verified and proven with several brownfields applications successfully using this approach.

For example, the full-scale performance of cells at Telfer was accurately predicted by dilution batch tests. The installation of a Jameson Cell ahead of each of two cleaner trains at the Telfer Site had a payback of between two and seven months and increased the copper recovery in the overall cleaner circuit from approximately 85 to 95 per cent. There was also an overall net benefit in concentrate quality.

Key Sources of Potential Advantage in Copper Applications

Carrying Capacity… Jameson Cells are renowned for high carrying capacities and the reason is due to the small bubble size, high contact efficiency and high froth recoveries due to a quiescent zone for froth recovery and small tank volumes and residence time.

An example of demonstrated carrying capacity improvements is in copper flotation where a pilot Jameson Cell was operated on the feed to existing columns and achieved significantly higher carrying capacities compared to the columns. Improvements up to a factor of three were seen. Direct comparison of pilot with full scale has demonstrated significant gold and molybdenum improvements as well.

Froth Recovery and Froth Washing… The small bubbles formed by the high shear jet in the downcomer and the high carrying capacity combine to form a very stable froth layer resulting in higher froth recoveries and the ability to efficiently wash the froth and improve concentrate grade. In specific cases circulating loads can be adjusted to increase the competition for bubble space and remove the less hydrophobic particles from the froth in favour of valuable minerals.

Even in copper/molybdenum, often much more challenging, there were significant gains to be made. Molybdenum requires high turbulence to achieve attachments to the bubble and the high turbulence in the downcomer and greater froth stability in Jameson Cells led to an increase in maximum recovery relative to columns. This improvement was also seen for gold flotation circuits, where fine gold is better recovered in a Jameson cell due to the high collection efficiency. Excellent gold recovery was always seen in the Alumbrera data from the earlier Mark 2 cells.

Circuit Positions for the Jameson Cell

The Jameson Cell has been tested, installed and metallurgically validated in all stages of a flotation circuit, including rougher scavenger positions, cleaning and recleaning. But it's the Rougher and Cleaner stages in which the Jameson Cell delivers the most value.

In comparison to multistage mechanical cleaning circuits, new circuits comprising Jameson Cells can replace two to three stages of traditional mechanical cell cleaning circuits. If further cleaning is required in the case of ultra-fine regrind circuits, it can be extended to include an additional third stage Jameson Cell.

Achieving high flotation rates (particularly for fines) needs small bubbles and intense mixing. But achieving high recovery of the slowest floating particles needs long residence times. Apart from the Jameson Cell, no technology has demonstrated the ability to achieve all of these simultaneously.

The Jameson Cell operates on a superior grade/recovery curve. Comparisons showed it produced a copper concentrate at 35 per cent Cu grade (the ore contains chalcopyrite and secondary copper minerals) in a single stage of flotation, while the operating plant could not consistently produce a final concentrate above 28 per cent Cu using two stages of cleaning in conventional mechanical cells.

In a range of tests carried out in copper-molybdenum circuits, high recoveries of copper and molybdenum were possible from the Jameson Cells in primary cleaning. For instance, improvements were seen in copper recovery to the copper concentrate (increasing from 65% to 80%) and in molybdenum recovery to the molybdenum concentrate (increasing from 25% to 60%).

The Jameson Cell is also strong in recleaning applications. It's able to produce fine bubbles by the shear action of its plunging jet and this allows the Jameson Cell to float particles quickly, attain superior selectivity and have high productivity (carrying capacity). The high carrying capacity is particularly useful when high mass pulls are required, such as re-cleaning.

Froth washing is one of the most effective methods to reduce entrainment and allow high grade clean concentrates to be produced. But conventional column cells have mixed results in froth washing because the slow flotation rates mean long flotation times and a large surface area, and to froth wash such a large area requires an impractical amount of water that would overload the rest of the circuit. Froth washing in the Jameson Cell, however, is extremely effective, due to the high carrying capacity and smaller froth area.

The Jameson Cell's intense mixing, smaller bubbles and reliability has led to a step change improvement in flotation circuit design. The introduction of cleaner scalper Jameson Cells to replace mechanical cells has demonstrated significant improvements. The cleaner scalper cells were able to produce a very clean concentrate at relatively high stage recoveries, typically between 50 and 70

percent at sites like Lumwana and Prominent Hill and between 85 and 95 percent at Telfer and Cobar.

The Potential Ahead for Copper in South America

The circuit performance of the Jameson Cell in copper operations, the flexibility of circuit position and the ease of use have shown the Jameson Cell to have a consistently positive impact in flotation circuit operability and on final product grade and recovery.

The size of the copper sector in South America, the pending decrease in ore grade and the deficit in concentrate production will mean that the Jameson Cell has a major role to play in better copper processing across the next decade.