Outotec China successfully completed the 150m$^3$ flotation cell retrofit project at Jinchuan Groups Ni-Cu facility in Jinchang. The retrofit improved recovery, reliability and availability of equipment. Costs were saved by reducing energy consumption and increasing mixing mechanism wear life. Process automation increased accuracy, quality and efficiency whilst also freeing up resources.

**CHALLENGES**
- Customer strives to improve Cu & Ni recovery
- Unpredictable rotor and stator failure
- Low level of automation across the concentrator plant

**SOLUTION**
- Laboratory kinetic and locked cycle flotation test work
- FloatForce® retrofit to five 150m$^3$ cells
- Implementation of advanced process control tools with FrothSense cameras

**BENEFITS**
- Increased recovery
- Energy reduction
- Increased wear life
- Decreased maintenance and downtime
- Improved accuracy and quality control
**Background**
Jinchuan Group is the fourth biggest nickel producer globally and the largest production site in China for nickel. Jinchuan concentrator facility is located near the city of Jinchang, Gansu province in China. The Ni-Cu deposits around the city of Jinchang have been operational for decades.

Jinchuan uses a bulk flotation method to beneficiate nickel and copper, which is done in two separate stages: a high grade circuit and low grade circuit. The high grade tailings are reground and then floated in the low grade circuit.

In early 2014, Jinchuan and Outotec collaborated to explore a debottlenecking study at their 14000 tonnes per day concentrator plant in Jinchang. This study focused mainly on flotation and concentrator level automation.

**Metallurgical test work**
Outotec conducted a series of test work during two periods to benchmark laboratory performance against industrial scale production. This included a thorough plant mass balancing exercise which was compared to labscale with 'hot' flotation kinetic tests, where plant samples were taken an re-floated in the laboratory scale with the Outotec-GTK labcell.

A second series of tests focused on locked cycle tests to compare laboratory performance with scaled industrial residence time. These tests indicated that a metallurgical performance improvement was possible and likely to occur in the low grade rougher-scavenger circuit which validated the execution of a retrofit project. This locked-cycle test study was also used to scale a future 11000 tonnes per day plant expansion.

The contract was awarded with a performance guarantee of 1.5% improvement in Ni recovery along the retrofitted cells.

**Outotec scope**
Retrofitting five non-Outotec 150m³ flotation cells in the low grade circuit with:

- FloatForce
- Automatic air feed controls
- ACT frothspeed control system
- Pulp level sensors
- FrothSense cameras

This retrofit enables our customer to control frothspeed which is highly correlated to the mass pull. The automation of the process minimises risks, allows for greater accuracy and better quality control whilst also freeing up resources.
FloatForce upgrade
The FloatForce upgrade improved the metallurgical performance and energy efficiency, whilst reducing operating costs with a new generation mixing mechanism. By improving flotation hydrodynamics and pumping performance at high air-dispersion rates, the FloatForce enhanced particle recovery in the flotation cell while at the same time reducing power consumption and the risk of sanding. The energy savings were measured at an 8% saving per cell with an extended rotor wear life.

Benefits of the FloatForce include:
- Enhanced pumping performance and energy efficiency
- Improved air dispersion into the process environment
- Increased wear life
- Quicker, simpler, and more cost-efficient maintenance

“\textbf{We can now run these cells without human control actions with improved stability on the cells.}” Stated a Jinchuan control room operator.

ACT Advanced process control
The addition of the ACT advanced process control system brought stability to the process and well as consistency to the plant’s operation. Less disturbance means less variance in process performance. Higher availability leads to more efficient utilization of capital as equipment is used at full capacity all the time – while a good human operator can reach production levels close to optimal, a good system will keep production at an optimal level.

Benefits of the ACT system include:
- Increased process stability and performance
- Efficient utilization of the process
- An open and easy-to-learn system with process visualizations
- Easily interfaces and connects to all existing plant control systems
Metallurgical improvement
The plant had an ideal flowsheet offering statistics on a line-by-line comparison study displaying before and after results. The comparison study was used to evaluate the metallurgical performance which revealed a significant improvement measuring a 1.9% higher recovery of nickel and 2.1% increase in copper without effecting the grade.

Summary
Our customer’s feedback was very positive stating Outotec was a reliable and trustworthy partner from start to finish.

Shift operators stated they were hesitant upon installation of the frothspeed controls, but now maintain that they cannot operate without it. The maintenance foreman indicated that during the first inspection the condition of the FloatForce mechanisms we like new and are a big step forward compared to the previous mixing mechanisms.

Outotec and Jinchuan Group continue their cooperation. This is the first operational FloatForce in large flotation cells located in China, and also the first retrofit project performed on this brand and type of flotation machine globally. This is a milestone project for Outotec China and the Beneficiation business line.

A statistically significant performance improvement was measured with 1.9% higher recovery of nickel and 2.1% increase in copper.