Novel control for froth flotation cells

Easy to implement control methodology for improved grade and recovery

Introduction

Mineral froth flotation is the largest tonnage industrial separation process in the world used for extracting valuable mineral contents in mining. A new simple, low cost, retro-fittable and field proven control system developed by engineers from Imperial Collage London, provides incremental improvement in productivity of the process. Field tests conducted in the prototype systems implemented in more than 20 sites around the world has also confirmed the significant improvement. Given the scale of operations, the value of mineral output and simplicity of implementation, the technology offers rapid payback.

The new control methodology achieves an optimal balance between grade and recovery, and is self-adjusting for variations in slurry content and process conditions. No existing technique provides both high grade and high recovery of the concentrate recovered from industrial flotation processes.

Technology

The technology developed is a control method that is able to increase the quantity of mineral recovered by maximising air recovery using the relationship between airflow and air recovery (Figure 1). Using the data from the height and velocity of the froth overflowing, the length or perimeter of the cell and the air flow rate into the cell, air recovery is monitored, measured and controlled non-intrusively. The parameters are measured or calculated by the help of image analysis techniques, which improves performance with respect to both the grade and recovery of the concentrate compared with known methods.

The system is low cost, simple to implement and install on existing and new equipment. It only requires a visual monitoring equipment, an analysis software and where necessary, actuated flow control valves. It provides automation to the process and precise control over air flow to increase productivity as well as improve energy and water efficiency. Due to its simple set-up, the system does not require high level of expertise to operate hence works on very low operational and maintenance costs. In addition it can adapt the changes in conditions of the system during the operation and maintain the same output.

Quick Info

Benefits

- Process optimisation to increase yield and output
- Rapid payback due to low cost and retro-fittable installation
- Full automation and adaptation to changing conditions during the operation.
- Minimising operational costs by water and energy efficiency management.
- Controlling multiple flotation cells in parallel or series.
- Eliminate the staff costs of manually operated control systems.

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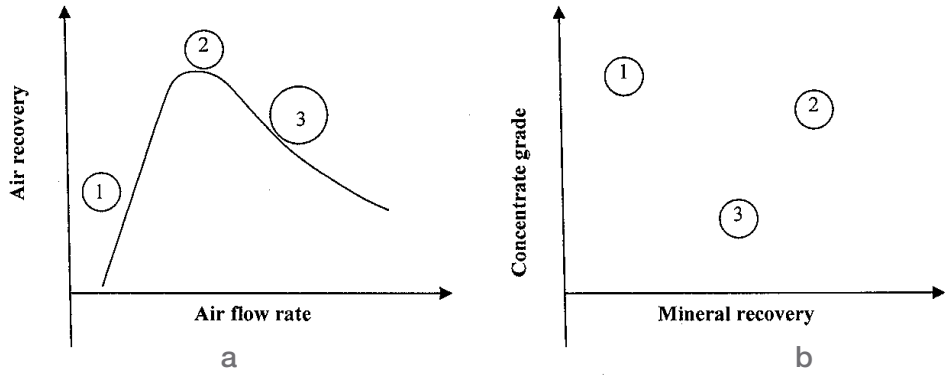

Figure 1

Statistical comparative tests at field trials from copper and gold operations have shown at least a 1% increase in copper and gold recovery, which is around 3000 tons of copper and 5000 oz (~142 kg) gold per year, corresponding an increase in revenue of c$15,000 to $10m per year at today's prices.

The straight-forward, automatable, Imperial College's method can control operation of froth flotation cells and improve the performance of the cells making the operation of the circuit more efficient and more cost-effective.

Results

The performance of the froth is controlled by the airflow used to create it. Air recovery, is a measure of the volume of air or other gas retained in the froth as it overflows from the flotation cell compared with the volume of air/gas used to create the froth initially. In other words it is a measure of the stability and effectiveness of the froth. Figure 1a shows the relation between airflow and air recovery. If the air flow is too low, a large number of bubbles burst in the froth, thus reducing the air recovery and the same issue re-occurs at higher air flow rates.

The performance quality of a flotation process depends on various factors such as composition of the ore feed, pH, additives used and air flow rate. Optimising the performance depends on managing the grade and recovery of the concentrate extracted. Grade indicates the fraction of the target mineral solids in the concentrate, while recovery is the fraction of the target mineral solids in the concentrate compared with the fraction of this material in the original ore feed. The goal is to get high recovery of high grade concentrate.

Figure 1b shows the relationship between grade and recovery based on the air flow rates at points 1, 2, and 3. The optimum point occurs at the peak air recovery (point 2).

Applications

- Process control
- Instrumentation
- Mineral separation
- Waste water treatment
- Paper recycling

Technology Readiness

Technology readiness level (TRL) of this technology is 6.

Intellectual Property

This technology has been patented and granted in nine territories: China, Peru, Australia, USA, Kazakhstan, South Africa, UK, Russia and Canada. Application pending in India and Brazil. Publication Number: **WO2009044149 A1**

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