REAL-TIME FLOTATION PROCESS OPTIMISATION AND IMPURITY CONTROL THROUGH IN-LINE GRADE MEASUREMENT

Karen Keet

Blue Cube Systems (Pty) Ltd, Stellenbosch, South Africa, karen@bluecube.co.za

INTRODUCTION

Flotation optimisation possibilities through real-time grade measurement are discussed in parallel to current strategies.

Data collection through plant surveys

Flotation optimisation has in the past become synonymous with sampling surveys. The sampling period is chosen according the process residence time and process stability is ensured before the survey commences. Error is introduced during the sampling process and the preparation of the samples for analysis. The more significant downside of using a sampling survey strategy for optimisation of a dynamic process is the turnaround time of the data. The turnaround time of the mass balance resulting from the artefact data collection discredits its relevancy.

Indirect parameters

Improved flotation performance can be achieved through operating a flotation bank at an optimum froth stability [1]. However, the conditions resulting in the optimum froth stability is as dynamic as the process. Realising the need for real-time measurement, Electrical Impedance Spectroscopy has been suggested and investigated for the quantification of froth stability [2]. Froth stability however remains an indirect parameter and the optimisation of the process rely on the stable correlation between recovery and froth stability.

Hydrodynamic and gas dispersion parameters were measured on industrial flotation cells in South African concentrators and was found to vary significantly [3]. Hydrodynamic data is very useful in modelling a process, but the data is captured in a similar fashion to typical sampling surveys and is similarly subject to a lack of significance .

Direct measurement

The proposed grade measurement is through simplified spectroscopy as supplied by Blue Cube Systems. In reflectance spectroscopy the sample is illuminated and the spectrum of the reflected light is captured by a spectrograph [4]. This method allows for in-line measurement and the data is supplied in real-time at a rate of every 20 seconds. Used together with a flow measurement, the grade and density data supplied by the in-line quantifier is used to calculate relative recovery (independent of feed parameters). Real-time measurement further allow the identification of true fluctuations and spikes in grade.

OPTIMISING THE MAINSTREAM FLOTATION CIRCUIT

For primary flotation the incremental feed grade, flow rate and density changes are not significant and therefore relative recovery is sufficient for real-time optimisation. Flash Float cells are installed between primary milling and primary classification on some Concentrators. Flash Float cells are known to contribute significantly to overall recovery. Its optimisation is therefore crucial and can easily be done through the availability of real-time grade data. A matrix of air rate, pulp levels and reagent addition combinations can be set up and executed. Instead of doing a typical survey (with buckets and stopwatches) the grade, density and flow data can be obtained from the historian for analysis in terms of relative recovery and grade. Figure 1 illustrates a typical Primary Flotation bank producing a 1st fast floating concentrate from the first cells and a 2nd slow floating concentrate product from the last cells. A similar matrix can be used to obtain the most suitable operating parameters that ensures the grade–recovery relationship required.

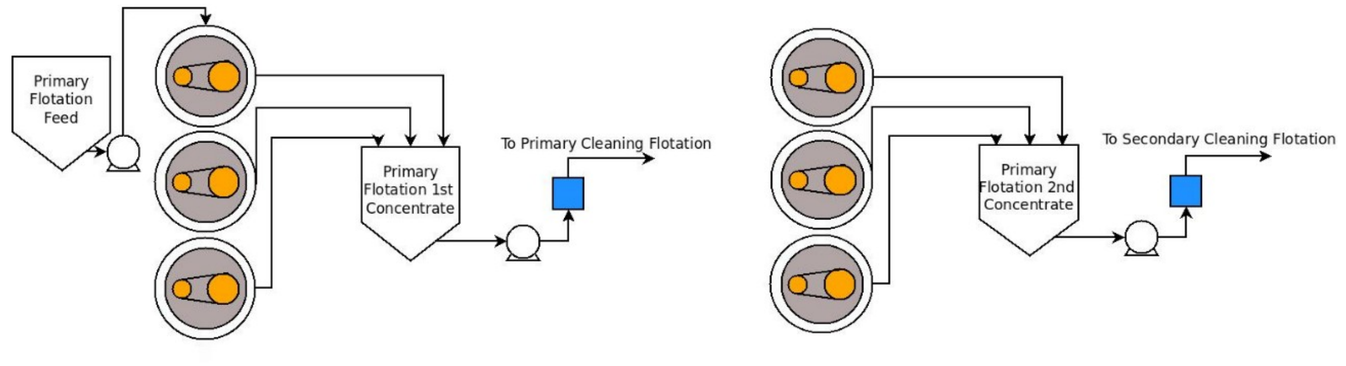
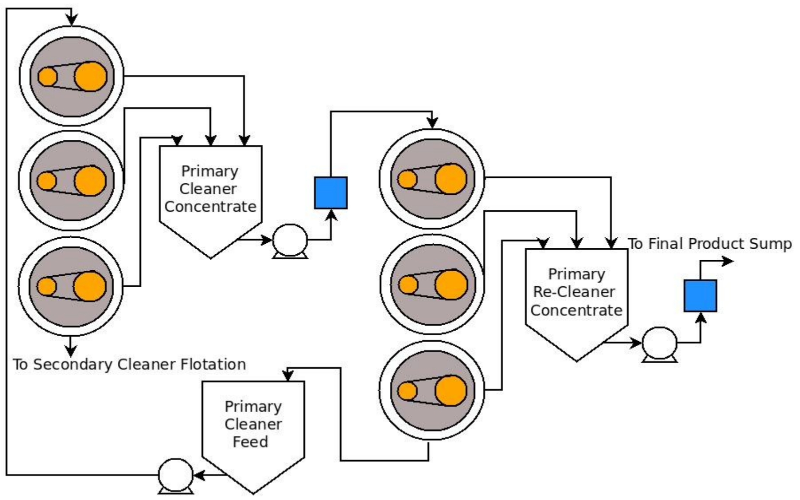


Figure 1: Typical Primary Flotation Flowsheet

Typical Secondary Flotation Circuits also have 1st and 2nd concentrates. Advanced optimisation can also be done by evaluating different options i.e. combining 1st concentrates and 2nd concentrates for cleaning or combining primary and secondary concentrates for cleaning.

OPTIMISING THE CLEANER FLOTATION CIRCUIT

Cleaner flotation has the objective to obtain the required grade, impurity and mass pull specification as prescribed in the company's business plan. Therefore primarily these three specifications will be pursued during the optimisation of Re-Cleaner cells and final concentrate columns (where installed).



Figu

re 2: Typical Primary Cleaner Flowsheet

For the optimisation of the Cleaner Flotation cells, relative recovery should also be considered to ensure that the grade of the Cleaner tails remain under control. An in-line grade quantifier can also be installed on the Cleaner tails line for monitoring or optimisation. If there is an option to open or close the circuit of the Cleaner tails to the mainstream, a grade measurement as input to a controller is beneficial.

REFERENCES

Hadler, K. and Cilliers, J.J. (2009) *The relationship between the peak in air recovery and flotation bank performance.* Minerals Engineering, Volume 22, Issue 5, April 2009, pp. 451-455. [1]

Shenggen, H., Ofori, P. and Firth, B. (2009) Monitoring of froth stability using electrical impedance spectroscopy. International Journal of Mineral Processing, Volume 92, Issues 1-2, 1 July 2009, pp. 15-21. [2]

Deglon, D.A., Egya-mensah, D. and Franzidis, J.P. (2000) *Review of hydrodynamics and gas dispersion in flotation cells on South Africa platinum concentrators.* [3]

Haavisto, O. (2009) *Reflectance Spectrum Analysis of Mineral Flotation Froths and Slurries.* Dissertation for the degree of Doctor of Science in Technology. Helsinki University of Technology (Espoo, Finland). ISBN 978-952-248-237-2. [4]