

The Implementation of FloatStar Grade-Recovery Optimisation Control Solutions using Blue Cube Online Grade Analysers on Industrial Flotation Circuits

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ABSTRACT

A challenge on many industrial flotation circuits is controlling concentrate mineral grades using measurements that are provided infrequently. The mineral grades in concentrate streams are a critical performance indicator in any industrial flotation circuit. Failure to achieve concentrate mineral grade targets has significant financial consequences on a flotation operation. A violation of gangue mineral grade limits by the concentrator may also result in significant penalties.

Online grade analysers which can provide reliable real time grade measurements are essential for effective grade optimisation. The Blue Cube MQi analyser (by Blue Cube Systems) has recently come to prominence for its ability to rapidly determine mineral concentrate grades online and has the benefit of operating in-stream. This has provided excellent insight into the actual process dynamics in the flotation circuit, and hence enabled real-time control and optimisation of concentrate mineral grades.

Mintek's Measurement and Control division, specialising in advanced control solutions for mineral and metallurgical industries, has had the opportunity to link the FloatStar Grade-Recovery Optimiser to the measurements provided by the Blue Cube system at one of the nickel concentrator plant in Africa. The project focused on stabilising the final concentrate grade while ensuring the final tailings are minimised, resulting in an improved nickel recovery. This site already had the FloatStar Grade-Recovery Optimiser for several years, but the original grade measurement device was unreliable and ultimately failed. The system was reactivated once the Blue Cube system was installed, replacing the old analyser. The positive results show the advantages of combining reliable real time measurements with an advanced process control system.

PERFORMANCE ANALYSIS METHODS

Delta recovery

The client measures the metallurgical performance by calculating the difference between the actual recovery achieved and the predicted standard recovery. This standard recovery is calculated by using the best historical plant performance to determine what the recovery should be for a given feed grade.

$$\text{Standard \% Ni Recovery} = M / (a \times M + b) \quad (1)$$

$$M = \frac{(f - t) \times 100\%}{(c - t)} \quad (2)$$

The actual recovery is calculated as per industry standard:

$$\% \text{ Ni Recovery} = \frac{(f - t) \times 100\%}{(c - t)} \times \frac{c}{f} \quad (3)$$

Where:

M = *mass pull*

a and b = *recovery factors for specified feed grades*

f = *\% nickel in feed*

c = *\% nickel in final concentrate*

t = *\% nickel in final tails*

Delta recovery calculates the difference between the actual % nickel recovery and standard % nickel recovery. The client's target was to achieve a delta recovery of 1%.

Note that it should be emphasised that sufficient historical data is required for the accurate values of the recovery factors for specified feed grades.

PERFORMANCE DATA AND DISCUSSION

Performance tests

The client conducted the on/off performance tests between February and March 2013.

Figure 2 shows the nickel recovery when the FloatStar Grade-Recovery Optimiser was activated and then deactivated over the first two weeks of the test campaign. The difference in nickel recovery was 1.83% in the first two weeks of the campaign.

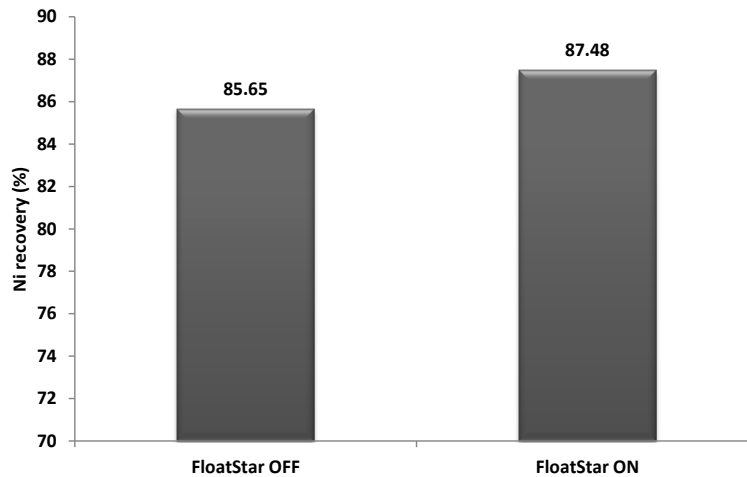


FIG. 1: Nickel recovery during first two weeks of the test campaign

Historical analysis – delta recovery

Figure 2 shows the monthly plant performance in terms of delta recovery over a period of three years starting from January 2010. Mintek completed the re-commissioning of the FloatStar Grade Recovery Optimiser in October 2012, and the long term results showed a further increase of 0.53% in delta recovery. Since October 2012 the average delta recovery has been maintained above the plant target of 1%.

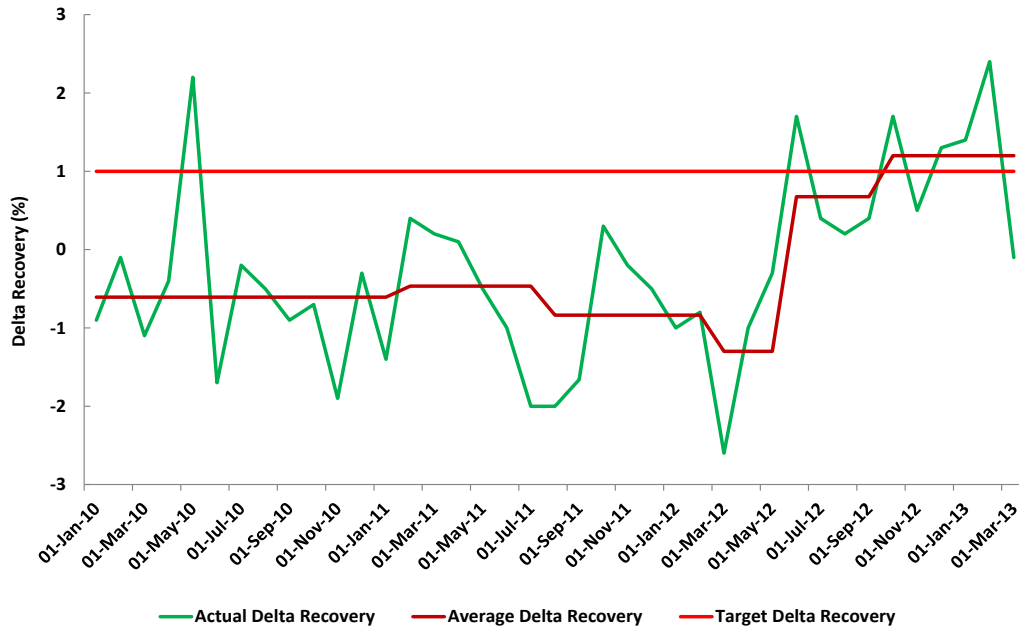


FIG. 2: Delta recovery over a period of three years

A drastic decrease in the actual delta recovery in the month of March 2013 was attributed to the oxidised stockpile (difficult to float) that was processed during this month. Based on the discussion with the plant personnel, the operation was normal again in the month of April in terms of the stockpile being processed. The delta recovery in the month of April was above target again (i.e. equals 1.3%) for the period when the FloatStar Grade-Recovery Optimiser was fully utilised.

CONCLUSIONS

Looking at the short term analysis during the period when the FloatStar on-off test campaign was conducted, higher nickel recoveries (1.83% improvement in the initial two weeks of the on-off test campaign) were achieved when the FloatStar Grade-Recovery Optimiser was activated. The FloatStar Grade-Recovery Optimiser was able to maintain the delta recovery at the desired target.

CONFERENCE

Full paper was presented at:

MetPlant 2013 – Perth, Western Australia, July 2013