

PERFORMANCE IMPROVEMENT PROVIDED THROUGH THE UTILISATION OF MINTEK AUTOMATION AND APC SOFTWARE ON A COPPER CONCENTRATOR

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ABSTRACT

In 2013 a copper concentrator in Zambia embarked on a project that was aimed at improving concentrator recoveries through the implementation of automated instruments and Advanced Process Control (APC) systems.

The project focused on automation and APC installations through the stabilisation of the mill feed, mill discharge on the two primary mills as well as the flotation circuit feed. Mintek's CyLas instruments (which providing a measurement of the hydrocyclone underflow angle) were also installed. The FloatStar Level Stabiliser controller provided flotation cell pulp level control on fourteen cells, including two columns.

Performance tests showed that the Mintek APC system stabilised the mill feed and mill discharge while ensuring the process remained within operational constraints. The MillStar control system utilised the CyLas instrument to prevent roping on the hydrocyclone underflow. This was not always achieved under normal operation. Additionally, the flotation section was stabilised as a result of improved level control by the FloatStar control system.

Performance comparisons showed that the Mintek control system improved the operation of the milling and flotation circuits resulting in a greater copper recovery.

PERFORMANCE DATA AND DISCUSSION

To assess the benefit and performance of the automation and APC system, comparisons of the cyclone feed density whilst under Mintek control and PLC control were compared as well as recoveries in conjunction with head grade measurements were analysed. A short term analysis involved comparing the performance of the Mintek control system to the performance of the PLC-based control system. The period of this assessment was from the 25th of February 2014 to the 9th of March 2014. During this time, the Mintek control system was scheduled to regularly be turned on and off with each 'on' and 'off' period being 16 hours in length.

Figure 1 shows a comparison of the combined cyclone feed density histogram for MillStar and PLC-based control for both mills. It can be clearly seen that MillStar achieved much tighter control of the density to setpoint than when compared to PLC-based control on both

mills. The results showed a large variation in the cyclone feed density from setpoint while under PLC control. This would result in an inconsistent feed to the flotation circuit as the feed density has a strong effect on flotation performance.

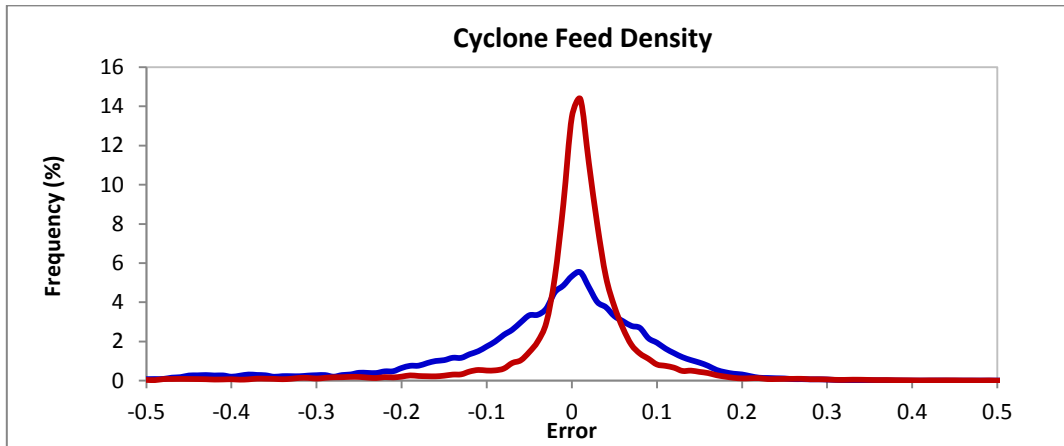


Figure 1: Cyclone feed density histogram for MillStar (■) and PLC-based control (■).

In order to quantify the overall performance of the plant, before and after the automation project (including installation of the Mintek control system), a detailed analysis of the monthly performance of the process was done.

The three phases are divided as following:

- Before automation (■)
- During automation and commissioning of the Mintek control system (■)
- After installation of the Mintek control system (■).

Figure 2 shows that recoveries have increased after the overall automation project despite the process operating with a lower head grade than before the automation process. The low recoveries achieved during the automation and commissioning phase can be attributed to the low head grades and disruptions to typical operating conditions.

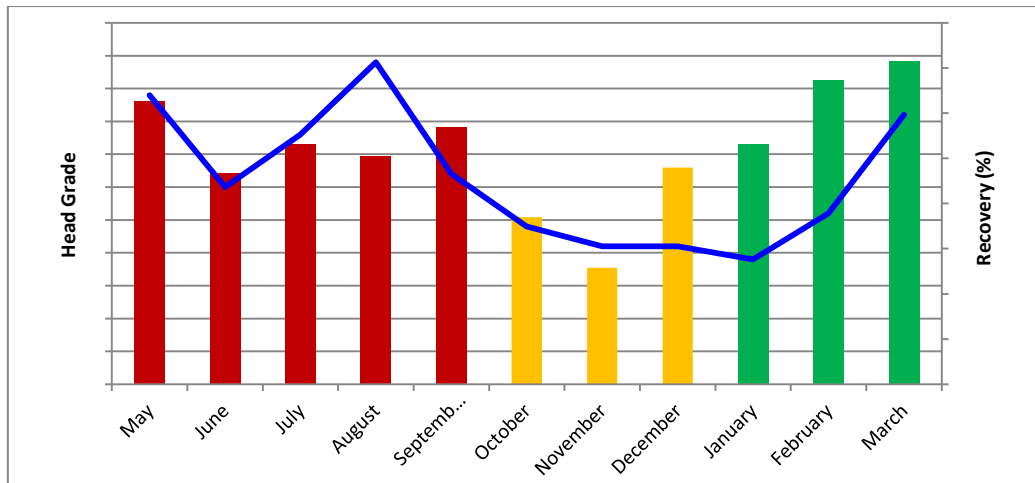


Figure 2 – Recoveries (■) and head grade (-) from before until after the automation project

Figure 3 shows the head grades for the typical, high and overall head grades for the process. High head grades calculated for the Off and On case are identical. Additionally, Figure 4 shows the percentage process improvement of the overall process utilising the Off case as a reference point. It is shown from Figure 4 that despite the lower head grade after the overall automation project, the plant was able to increase recoveries by 0.78 % and the concentrate grade by 1.71 %. It is shown in Figure 4 that for high head grades the plant was able to increase recoveries by 0.70 % and the concentration grade by 0.28 %.

At the higher head grades shown in Figure 3, the benefits of the overall automation project is expected to be lower as the process is already inherently more efficient under these conditions. Therefore the improvement in recovery is lower but still satisfactory. The improvement in recovery is more significant under typical feed grade conditions. The real benefit of the system is under low head grade conditions as the system still improves both recoveries and concentrate grade.

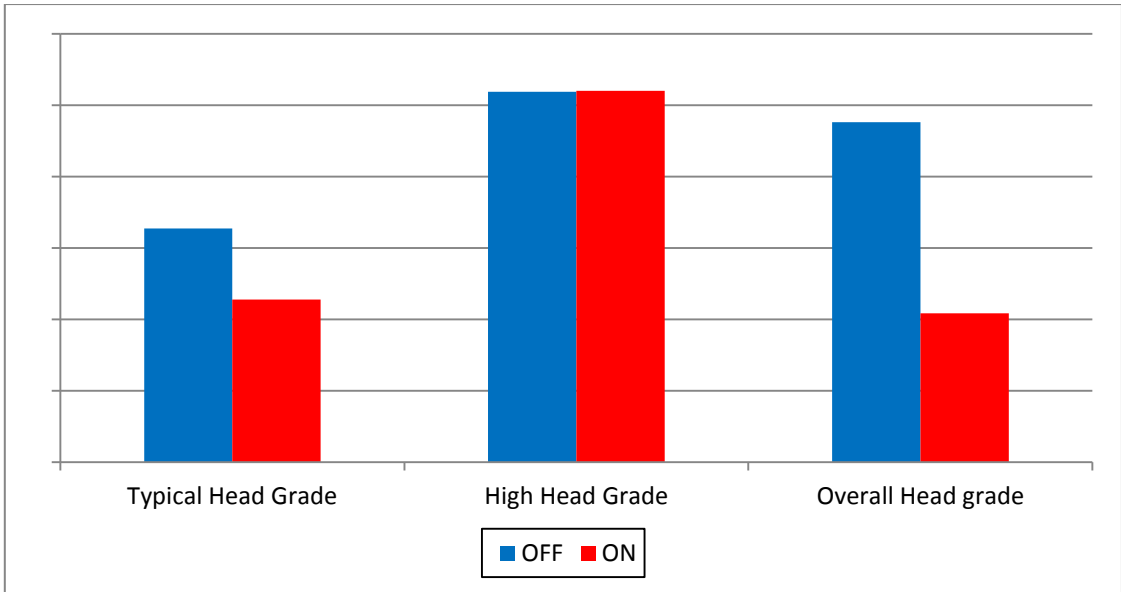


Figure 3: Typical, high and overall head grade measurements

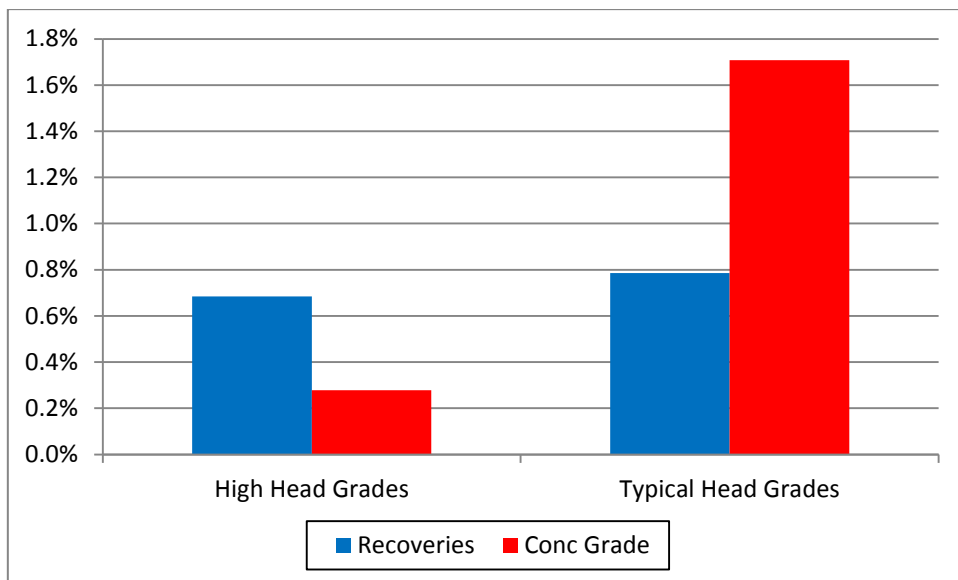


Figure 4: Percentage process improvement for overall automation project using OFF as a base case

CONCLUSIONS

From the results obtained, it can be concluded that the Mintek control system is able to achieve its primary objective of stabilising the milling and flotation circuits.

The implementation of the MillStar system has provided a more consistent cyclone feed density, thereby improving the consistency of the final grind as well as stabilising the density of the feed to the flotation circuit.

The results have also shown that when compared to performance prior to automation project, the overall automation project has improved the copper recoveries by a minimum of 0.7 % (with high feed grades) and reached a maximum improvement of 1.3 % (with low feed grades). The overall automation project and installation of an APC system was also able to improve the concentrate grade under both operating conditions.

REFERENCES

Coetzee, L. C. (2014). Stabilising and optimising a primary closed-loop milling circuit feeding a flotation circuit using RNMPC. *IFAC World Conference*. Cape Town.