Milling and flotation advanced process control system at a base metals concentrator

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ABSTRACT

The original commissioning of the MillStar and FloatStar Stabilisation and Optimisation control systems at one of the base metals concentrators in Mexico was completed in January 2008. After a few years of operating their milling and flotation circuit under the MillStar and FloatStar control systems, the plant embarked on a project to retrofit their concentrator. On completion, Mintek was requested to re-commission the MillStar and FloatStar control systems at the concentrator, which was subsequently completed in 2012. The MillStar system focussed on stabilising the feed to the SAG mill as well as stabilising densities at the discharge end of the SAG mill and two ball mills. The results showed that the MillStar APC system stabilised the mill feed and mill discharge without violating the circuit's operational constraints. Two layers of the FloatStar control system were installed, for flotation cell level stability as well as grade and recovery optimisation. The FloatStar Grade Recovery Optimiser was configured to control the concentrate grade of Lead (Pb) and Zinc (Zn) without violating the recovery constraints of these minerals, as well as froth velocity constraints on some of the flotation banks. Furthermore, on the Lead-Copper separation section, the FloatStar Grade Recovery Optimiser was configured to minimise the Lead grade in Copper (Cu) concentrate, thereby improving Copper concentrate grade and recovery. The Amdel online grade analyser was used to provide grade measurements for optimisation. Despite the low frequency in grade measurements from this analyser, the FloatStar Grade Recovery Optimiser (FSGRO) was still able to maintain the final concentrate grade of Pb, Cu and Zn at optimised mineral recoveries.

PERFORMANCE RESULTS

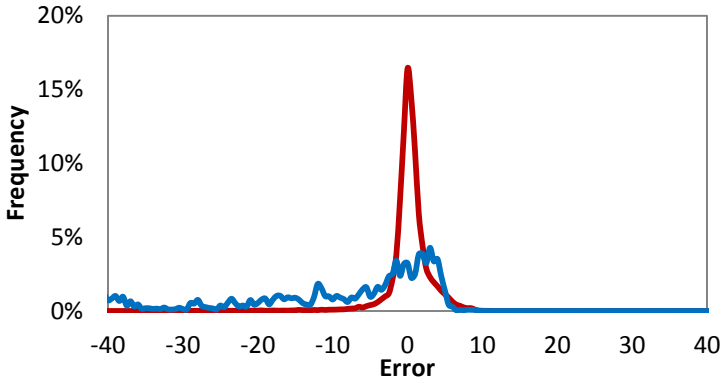

Figure 1 SAG mill cyclone feed density histogram for MillStar (■) and plant PID control (■)

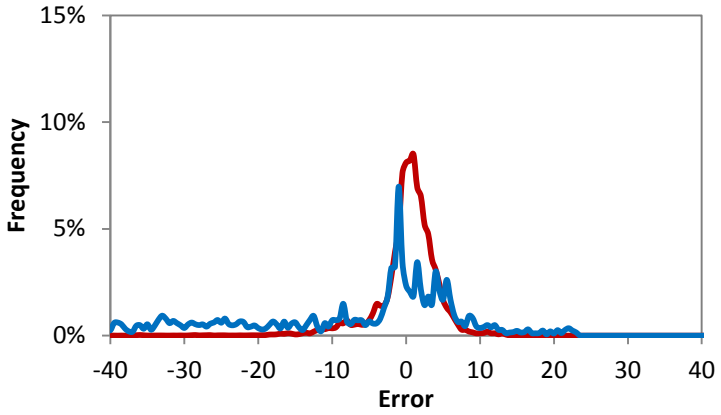

Figure 2 Ball mill two cyclone feed density histogram for MillStar (■) and plant PID control (■)

Data from January to March 2011 was used for the plant PID controller, from January to March 2012 for the FloatStar Level Stabiliser (FSLS) control system and from January to March 2013 for the analysis of the FSGRO control system's performance. The 2011 data was used for plant PID controller since the client immediately adopted the use of the FloatStar control system as a primary control system after commissioning was completed.

Table 1 Comparison of Pb, Cu and Zn grades and recoveries during plant PID control, FSLS control only and both FSLS and FSGRO control

Variable	Units	Plant PID	FSLS Only	FSLS & FSGRO
Pb grade in feed	(%)	1.33	1.22	1.23
Cu grade in feed	(%)	0.35	0.36	0.38
Zn grade in feed	(%)	6.47	5.80	5.81
Pb final concentrate grade	(g/t)	22.73	21.34	22.20

Cu final concentrate grade	(g/t)	25.01	26.07	27.96
Zn final concentrate grade	(g/t)	50.99	51.07	51.10
Pb Recovery	(%)	66.95	68.57	71.56
Cu Recovery	(%)	66.15	70.16	74.11
Zn Recovery	(%)	79.93	79.31	79.52

Note that from the discussion with the client, there were a few changes made to the process and this included reagents, pH control, flotation circuit design, as well as process water quality being used. In addition to the control system, these changes might, to a certain extent, have attributed to the recovery improvement observed for Pb and Cu. However, some of these process changes could not be possible without a reliable advanced control system in place.

Figure 6, **Figure 7** and **Figure 8** provides a graphical illustration of the daily averaged final concentrate grade and recovery data for Pb, Cu and Zn respectively.

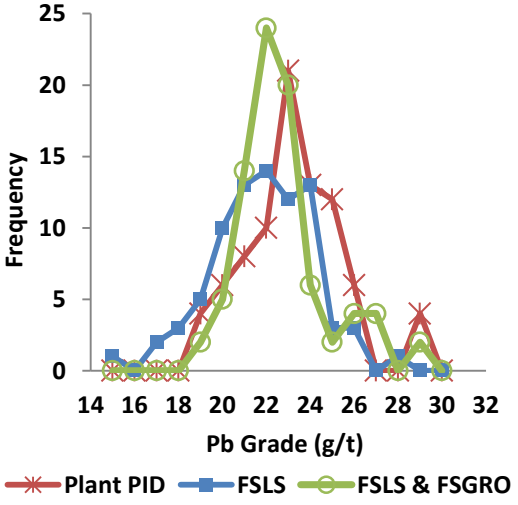

Figure 3a Pb Grade

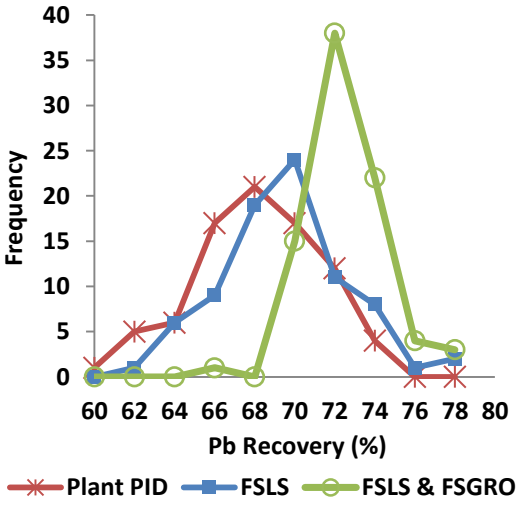

Figure 6b Pb Recovery

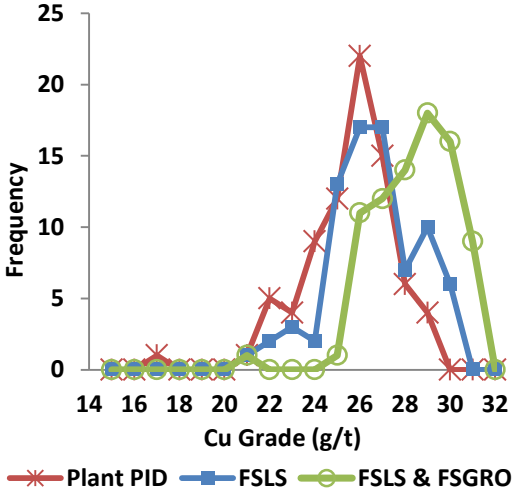

Figure 7a Cu Grade

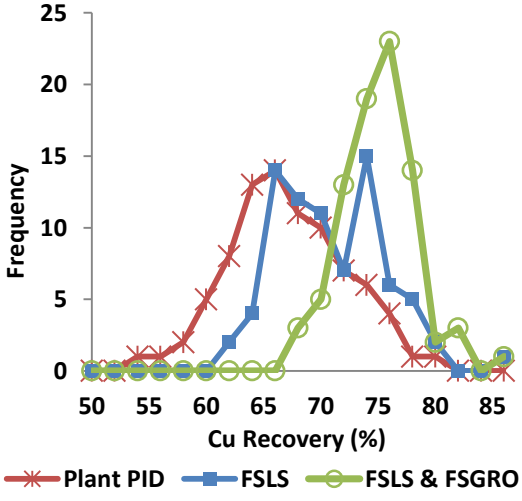

Figure 7b Cu Recovery

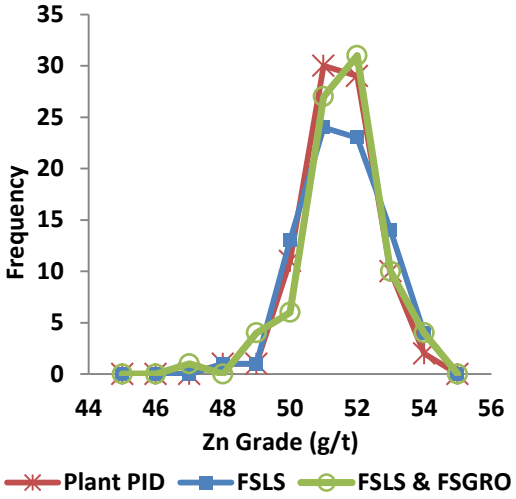

Figure 8a Zn Grade

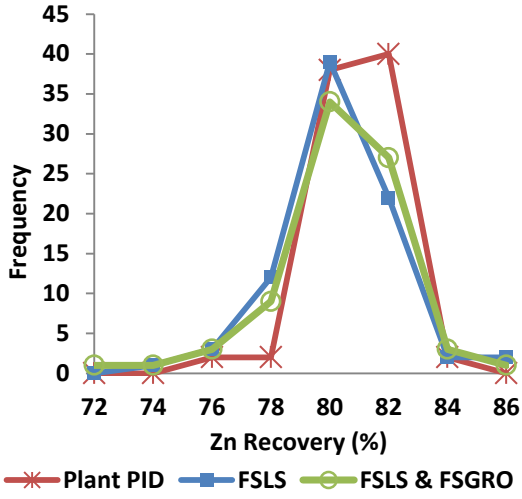

Figure 8b Zn Recovery

CONCLUSION

The MillStar control system showed a measurable improvement in cyclone feed density stability compared to plant PID controller. The stable density assists in improving the consistency of the final grind as well as stabilises the density to the flotation circuit, thereby complementing the FloatStar control system to ensure efficient flotation control.

The analysis of the data revealed that the FloatStar stabilisation and optimisation control systems were able to provide a significant improvement in mineral recoveries while maintain a desired product quality.

CONFERENCE

Full paper was presented at:

Procemin 2013 – 10th International Mineral Processing Conference, Santiago Chile, October 2013