CONTROLLED ZINC DUST DOSAGE FOR COPPER CEMENTATION ENABLED BY REAL-TIME COPPER CONCENTRATION

S. Malan[*] & K. Keet[**]

[*] Scorpion Zinc [**] Blue Cube Systems (Pty.) Ltd.

ABSTRACT

Scorpion Zinc is the first mine-to-metal operation to commercially apply a purely hydro-metallurgical process route to exploit a zinc oxide ore body. Copper and Nickel are not co-extracted during the applied solvent extraction (SX) process and are recycled back to the leaching circuit. To prevent a built-up of impurities, copper is removed through cementation from the pregnant liquor solution (PLS). The cementation process is induced by the addition of zinc dust followed by filtration to remove the cemented copper from the solution. The dosing rate of zinc dust is controlled by measuring the concentration of the remaining copper in the purified solution. The effective control of the zinc dust addition demands a high frequency of copper concentration data. Through newly developed technology based on absorption spectroscopy, real-time data was made available for the automatic control of the zinc dust addition resulting in significant financial savings.

1. Background

The Skorpion Zinc ore body consist of a zinc-sulphide ore that has been oxidized through severe weathering. The zinc-oxide deposit is futher complexed with the presence of limestone, resulting in a unique ore type for processing. The main hydrometallurgical processes following comminution includes leaching with sulphuric acid, neutralisation with $CaCO_3$ and solvent extraction. A side stream from the pregnant leach solution (PLS) reports to a purification circuit where zinc dust is added for the cementation of copper.

In 2007, a set of solution samples was submitted to Blue Cube Systems for a pre-amenability study. The aim of the study was to determine if the on-line grade and mineral quantification technology is amenable for the intended application at Skorpion Zinc. The outcome was positive where all major components in the solution samples appeared highly visible to the optical scanner with adequate differences to quantify the different elements, indicating that the scanner could suitably be applied on Skorpion Zinc solutions.

Based on these results, an on-site trial was conducted to further investigate the accuracy and overall performance of the technology in the copper plant. The main objective for selecting the copper plant was to optimise zinc dust consumption, and consequently the operating costs thereof.

2. Zinc dust control through real-time data

Prior to the installation of the on-line unit, zinc dust addition to the copper cementation was controlled using lab analyses from manual samples taken by operators. Analytical results typically become available after 12 hours to a day later, resulting in the zinc dust dosing system to rely on outdated data to control the process. Optimising the zinc dust addition became very complicated due to the delayed feedback of the process response to changes in the zinc dust addition.

The on-line analyser in the copper plant facilitated zinc dust optimisation through the availability of real time copper analysis which allowed real time process control. Rapid response to zinc dust addition is valuable to optimise the consumption and the cost thereof. This was also beneficial for process optimisation due to the real time information availability which allows immediate response to any process changes.

3. Results from on-site trial

Cost saving through zinc dust control

On average, zinc dust consumption through the copper cementation plant was approximately 60 tonnes per month. A 10% reduction on consumption was achieved which resulted in N$125,786 cost saving per month and in excess of N$1, 5 million per year.

In addition; the controlling of the zinc dust according to process requirements, reduced the effect of excess zinc addition, which normally resulted in high zinc content in the copper cake. This improved the total quality of the copper cake and sales cost by reducing the contamination penalties. This was confirmed by the quality of the copper cakes during the trial period.

Table 1: Copper revenue contract

Copper Content (%)	Percentage of London Metal Exchange (LME) price payable
<30%	To be negotiated
30-34.99%	32%
35—39.99%	36%
40—44.9%	40%
45—49.9%	42%
50—54.9%	44%
55-59.9%	46%
60—64.9%	48%
65-69.9%	50%
70%>	52%

According to the above mentioned copper revenue contract, an increase in copper content of five percent (5%) results in a two percent (2%) increase in the payable price. Improving the cake quality from 50-54.9% copper content (at 44% LME payable) to 55-59.9% content (at 46% LME payable), would equate to N$ 400,000[1] additional revenue per year.

Correlation between measured data and on-site analytical data

Results from the data validation survey showed good correlation when compared to the on-site analyses, indicating that the in-line scanner could be suitably applied. Figure 3.1 and Figure 3.2 below illustrate the correlation between Skorpionzinc data and the MQi (on-line scanner) data for the copper and the nickel respectively.

1 Based on 580 mt per annum and N$32,750 per tonne copper - Jan 2009 prices.

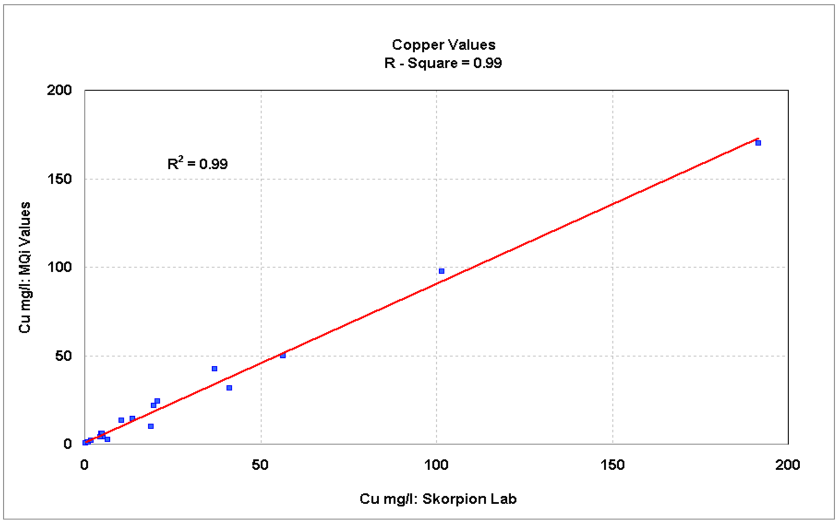

Figure 1: Copper parity chart

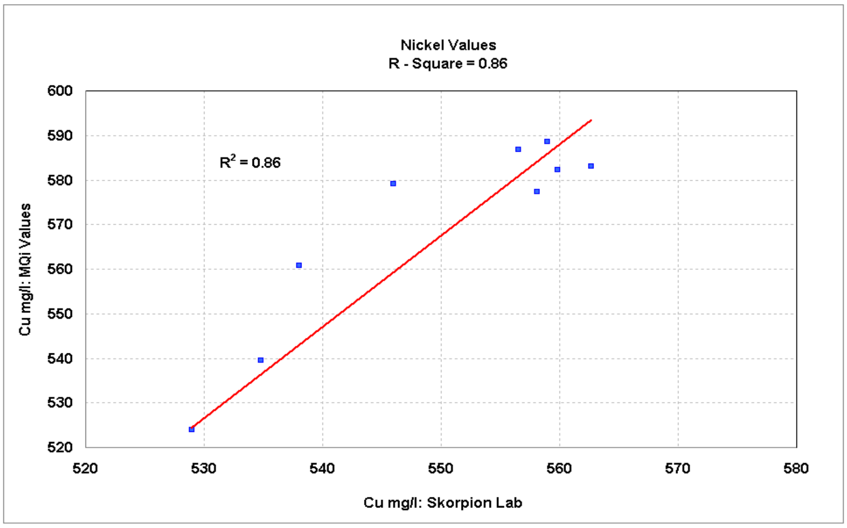

Figure 2: Nickel parity chart

Results from the process control survey showed good performance when controlling the copper content in the filtrate. A copper content set point of 50 mg/l was achieved continuously compared to copper content of higher than 200 mg/l ppm at times prior to the implementation of process control.

Effect on the copper cake

With the zinc dust addition effectively controlled, the amount of zinc in the copper cake was also reduced. Samples taken during the trial period had a lower copper content in the cake compared to samples taken during normal zinc addition.

Table 2: Copper cake samples showing cake quality with MQi control and during normal control

Process condition	**Cu [%] in copper cake**	**Zn [%] in copper cake**
MQi trial zinc dosing system	60	5
Normal zinc dosing system	50	10

Real-time data as tool for troubleshooting

During the survey, it was discovered that the unit could be used as guidance in troubleshooting the zinc dust dosing system by monitoring the copper content in the solution. During periods when dosing valves were choking, it was discovered that an increase in copper content (regardless of the valve opening) can be used as an indication of insufficient zinc dust in the system, thus quickly probing operator intervention.

In the absence of the availability of the copper content, operators depend on the level of the supply tank. The zinc dosing system feeds to both the nickel and copper circuits with take-off points in the main circulation line. With both circuits in operation, it takes longer to detect irregularities in the dosing system through the drop in the tank level, as one of the plants might still be dosing and thus the tank level dropping.

4. The importance of high frequency data

For process control to be successful, aliasing must be combatted. Aliasing occurs when sampling intervals are spaced out in such a manner that the true dynamics of a system is not captured. A subsequent controller receiving the false information would react by:

- steering the process in the wrong direction
- steering the process in the correct direction, but at a faster response than required
- steering the process in the correct direction, but at a slower response than required

5. The technology enabling high frequency data

The technology used for the collection of the real-time data is based on absorption spectroscopy. For application in solutions, particulate matter must be filtered out prior to measurement. The unit measures the optical characteristics of the solution through illuminating the stream and capturing the absorbed spectra. The absorbed spectra are directed to a spectrometer where the spectral profile is measured and recorded. To produce a useful output, the scanner must be set up to first detect the differences in the optical “fingerprint” as the solution passes the scanner. The differences are then interpreted and translated into the relative concentration of the components present in the solution.

6. Conclusions

The on-site trial proved successful. The on-line analyser in the copper plant facilitated zinc dust optimisation through the availability of real time copper analysis which allowed process control. A reduction of 10% in zinc dust was achieved resulting in a cost saving of approximately $125,786 per month. A further financial benefit was found in the quality of the copper cakes. The quality of the copper cakes improved as the zinc dust was controlled and the excess zinc minimised. The data from the on-line analyser also serves as a tool for troubleshooting during operation.