

Case Study:
Minerals processing,
froth flotation

***Direct measurement of
concentrate grade is a key
factor for optimum flotation
cell performance.***

- Application: Grade control of final and flash flotation concentrate
- Year: 2009
- Site: Northam Platinum UG2 concentrator

NORTHAM
PLATINUM LIMITED

Final concentrate grade measurement at the Northam Platinum UG2 Concentrator

The Blue Cube MQi Inline Mineral Quantifier for Froth Flotation Slurry is already widely used in platinum concentrators.

The metallurgical team at Northam Platinum recently installed and tested a Blue Cube MQi on their final concentrate line to enable optimum operation of the final cleaner flotation columns.

Metallurgical manager Danie Minnaar's question "Can something good come from Stellenbosch?" was answered when Technical superintendent Daan Smit presented the test results as shown in Figure 1, below.

After calibration, the unit was tested with independent samples. Four sets of ten samples were taken after adjustments to the external sparger column cells. The MQi showed excellent consistency and accuracy when compared to traditional laboratory analysis.

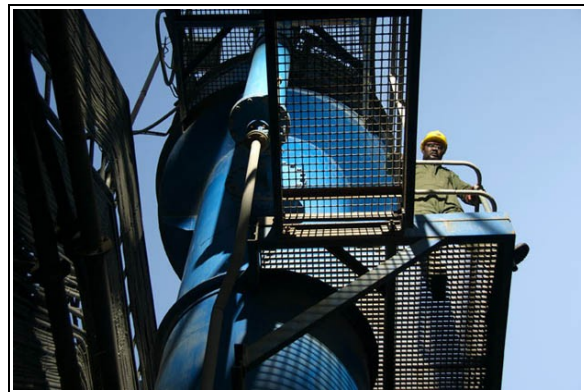


Illustration 1: Northam external sparger column cell

Figure 1: MQi vs XRF for chromite

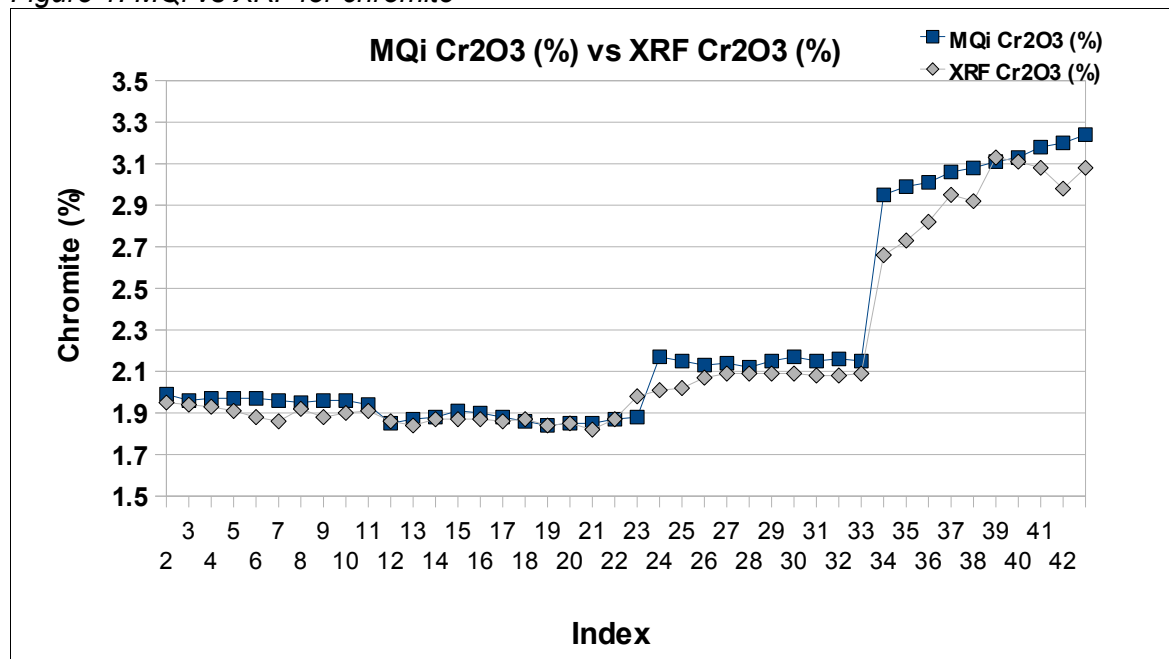
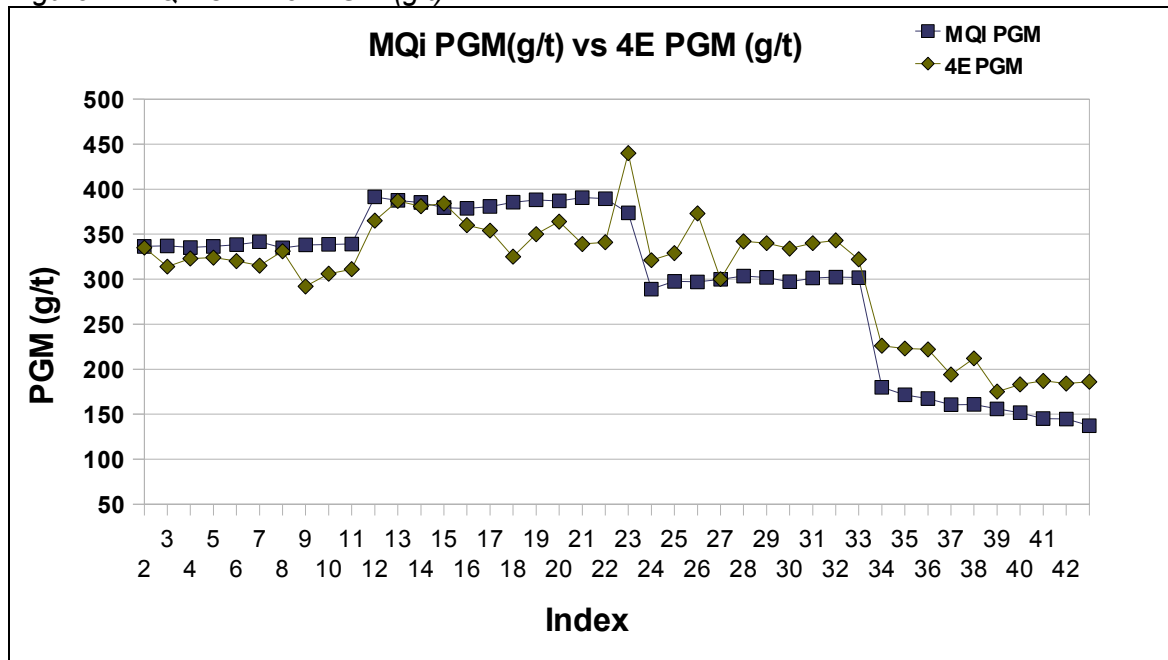


Figure 2: MQi vs 4E for PGM (g/t)



From the data in the above graphs the following were calculated:

The accuracy of the Blue Cube MQi is defined as the average of the absolute differences between the Blue Cube MQi measured values and those of the corresponding control analyses.

The precision of measurement of the Blue Cube MQi is defined as the standard deviation of the differences between measured values and the average during stable sampling periods.

It is evident from both the XRF and MQi results that the mineralogy during the fourth period changed, therefore only the first three periods were used to determine this parameter.

For PGM (g/t)

Accuracy of measurement:	32 (g/t)
Precision of measurement:	4.17 (g/t)

For Cr₂O₃ (%)

Accuracy of measurement:	0.08 (%)
Precision of measurement:	0.02 (%)

The square of the Pearson product-moment correlation coefficient (RSQ) was calculated and is shown in the table below.

	PGM (g/t)	Cr ₂ O ₃ (%)
RSQ	0.84	0.92

From the above results it is evident that the Blue Cube MQi instrumentation is eminently suitable for process monitoring and control. The output is generated in real time, and the result of any process adjustment is visible instantaneously.

Flash flotation at Northam Platinum: Maximising PGM recovery

After the successful implementation of a Blue Cube MQi on their UG2 final concentrate line, **Northam Platinum** installed a second Blue Cube MQi in their flash flotation concentrate line. The benefits of flash flotation have long been known, but the Blue Cube MQi application adds a valuable new dimension to this flotation technology.

The Blue Cube MQi unit measures the PGM (g/t) and Cr₂O₃ (%) concentration of the flash flotation cell concentrate in real time. This flash flotation concentrate then joins up with the re-cleaner concentrate in feeding the final cleaner columns.

Spearheading this application at Northam were metallurgical manager, Danie Minnaar, and Technical superintendent, Daan Smit. Together with the rest of the team, they implemented an automatic Cr₂O₃ grade controller on the flash flotation cell.

The PI controller utilises the Blue Cube MQi output to control the chromite (Cr₂O₃) content at a desired set point by adjusting the airflow rate to the flash flotation cell.



The Flash Flotation Blue Cube unit.

Shown left is the inline Blue Cube MQi unit with the poppet sampler assembly.

Northam Technical superintendent Daan Smit with Van Wyk du Plessis, the Blue Cube Systems engineer responsible for commissioning the unit.

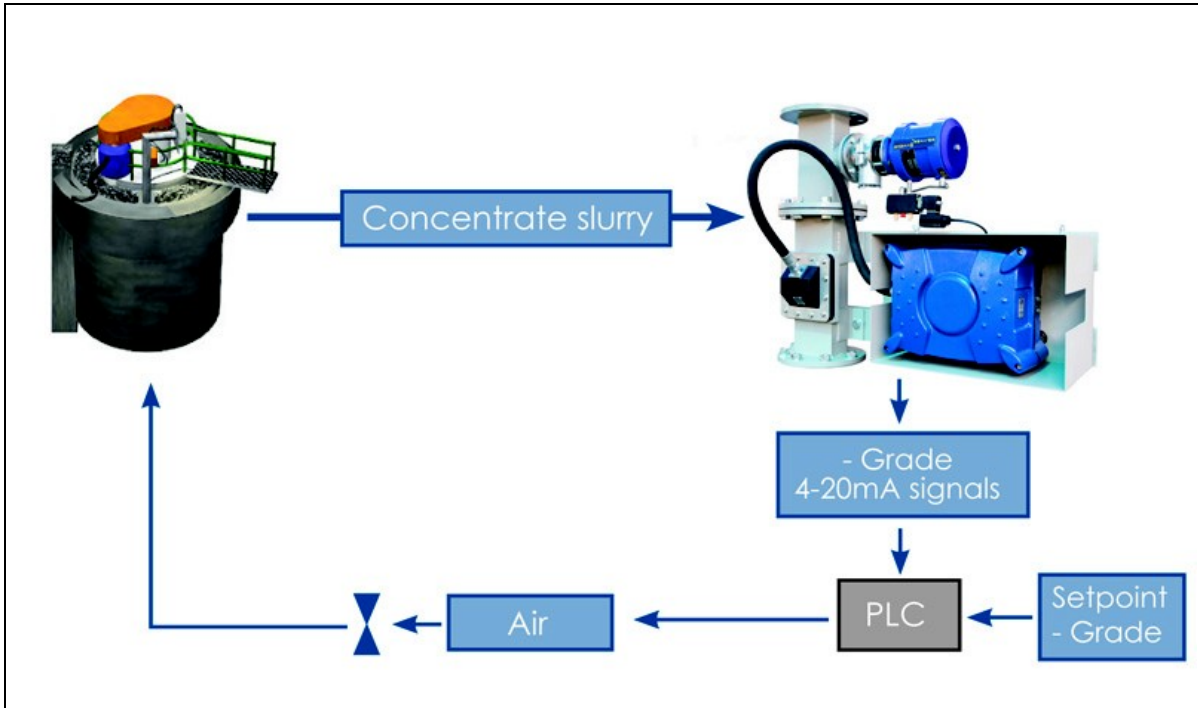


Illustration 2: Schematic of the automatic control loop

The following graphs show the chromite grades from the flash cell concentrate for a number of hours. Figure 3 shows the substantial deviations before control. After tuning the control loop, the chromite grade is controlled at a stable value between 3 % and 4 %, as shown in Figure 4.

Figure 3: Chromite variation: 2 February 2009.

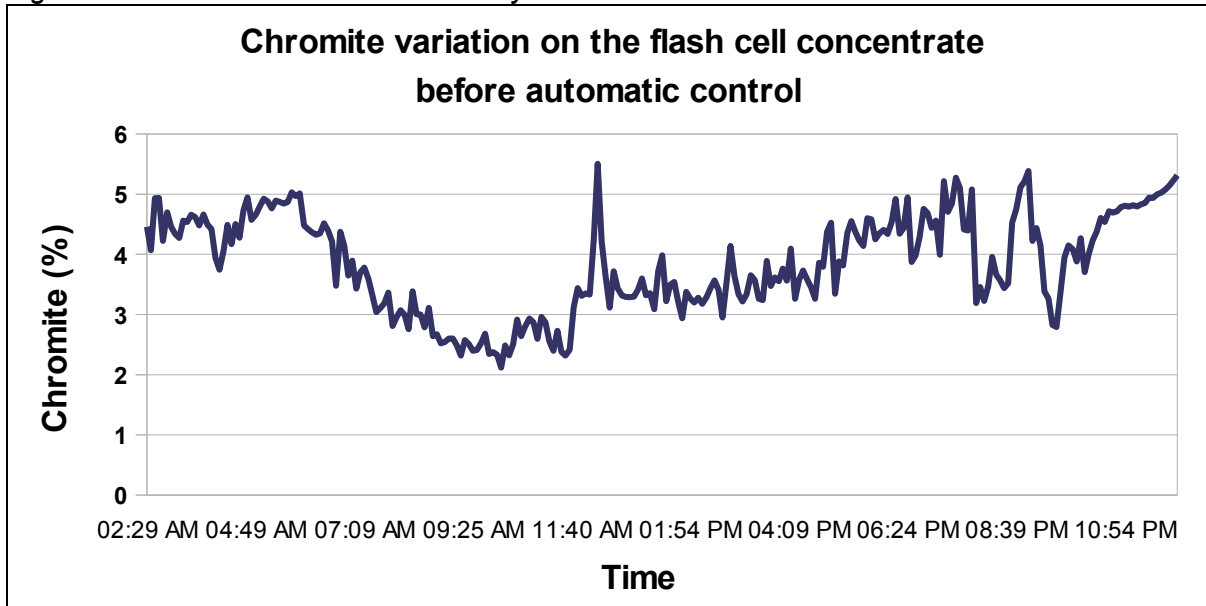
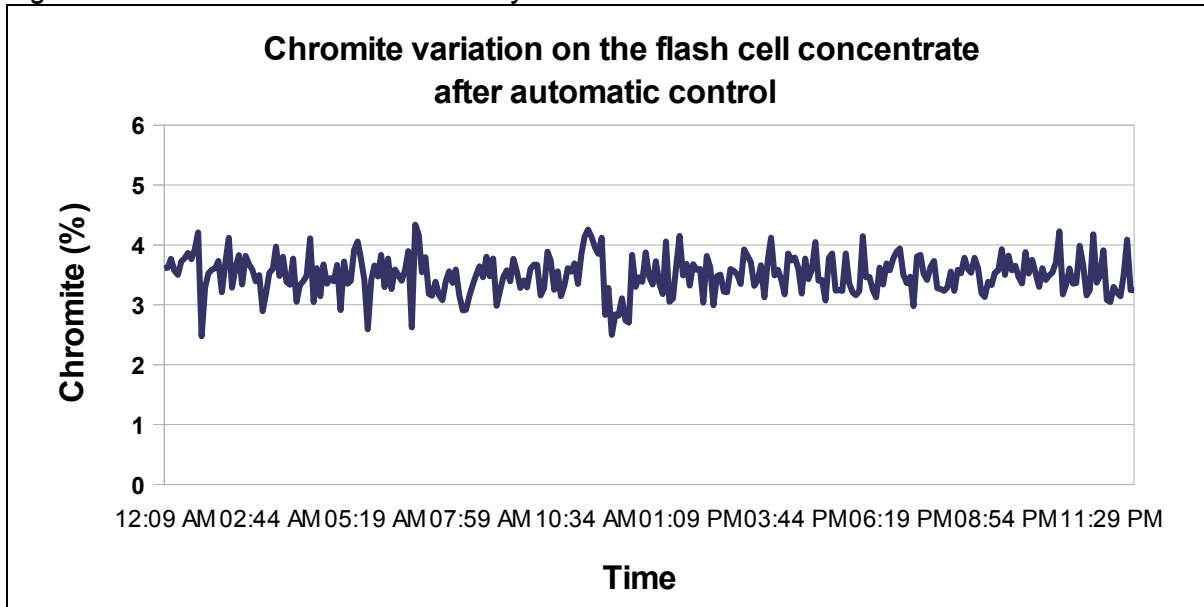


Figure 4: Chromite variation: 6 February 2009.



Blue Cube directors visited Northam to congratulate the Northam staff on their achievements.

Pieter de Waal and Francois du Plessis, both directors of Blue Cube Systems (Pty) Ltd, with Northam metallurgists Daan Smit and Johan Janse Van Vuuren.

Following the installation of the two Blue Cube units in strategic places in the UG2 concentrator, the net results were as follows:

- PGM recovery was maximised while maintaining Cr_2O_3 in concentrate within specification.
- Cr_2O_3 in final concentrate was controlled in real time, preventing Cr_2O_3 associated penalties.

Controlling the flash cell concentrate at the desired Cr₂O₃ grade constitutes the following benefits:

- Maximise the flash cell PGM recovery without exceeding the final product Cr₂O₃ specification.
- Optimised overall PGM recovery.
- Reduced over grinding of PGMs and resultant losses to slimes.
- The whole system runs under fully automatic control. There is no human hand involved.
- Sampling of flash flotation concentrate is controlled by the Blue Cube MQi, by means of an inline poppet sampler.
- Reduced penalties for concentrate exceeding 1.5 % chromite content.
- Plant adjustments can be based on facts, not on the intuition of operators.
- Measurement of in-line real-time sample composition without any hazardous components, permits or appointment of responsible persons.
- Reliable equipment designed for harsh plant conditions.
- Local service and support.

Blue Cube Systems, a technology company based in Stellenbosch, Western Cape, South Africa.

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The Blue Cube MQi provides additional revenue and, by avoiding the penalties associated with Cr₂O₃ in concentrate, results in improved performance, with immediate and substantial improvement to the bottom line.

It is common for the investment in a Blue Cube MQi to result in a net positive cash flow from the first month onwards.

Metallurgical manager, Danie Minnaar, concludes: "The performance of the Stellenbosch product exceeded all my expectations."