MetPlant 2015
Plant Design & Operating Strategies – World's Best Practice

CiDRA® Minerals Processing

Rio Tinto

Process optimisation using real time tracking of coarse material in individual cyclone overflow streams

Dylan Cirulis, Robert Maron, Christian O'Keefe, Paul Rothman, David Newton, Joseph Mercuri; **CiDRA Minerals Processing, USA**

Jennifer Snyder, Scott Dunford, Erik Bartsch; **Rio Tinto, USA**

Introduction

- Bingham canyon mine
  - copper porphyry ore body.
  - Sulfide mineralisation predominantly chalcopyrite
  - copper head grade 0.4 to 0.6 %
- SABC circuit with average throughput of 168kt/d
- Mineral recovery strongly linked to particle size distribution
- Industry partnership between Rio Tinto and CiDRA developed a novel technology for particle measurement in individual cyclones

Current Challenges

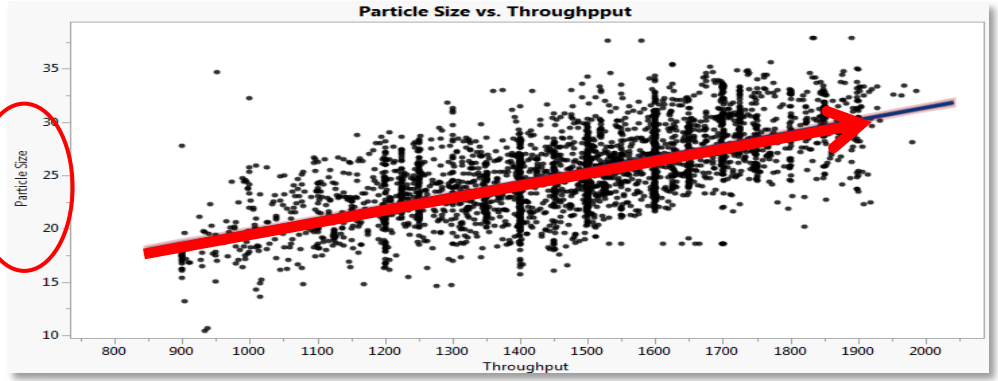
- Falling head grades mean operations must maximize throughput while maintaining mineral recovery

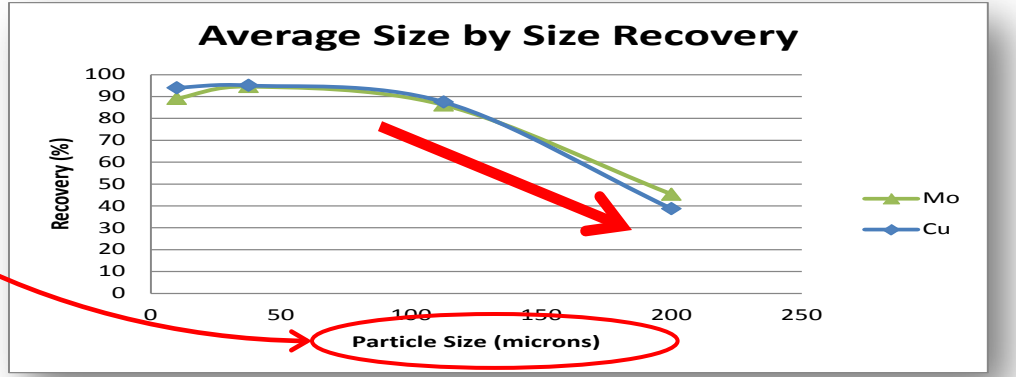
- A reliance on fewer milling circuits has resulted in an increase sensitivity to ore type changes and feed rates. Detecting these changes sooner will minimize performance impact (Jones and Pena, 1999)

- Grind size is a critical KPI because it directly impacts mineral recovery as well as the plant grind efficiency

Controlling Grind Size is Critical

- As throughput increases, particle size increases
- As particle size increases, recovery decreases (liberation, coarse particle flotation)
- Therefore particle size is a key parameter for both throughput and recovery



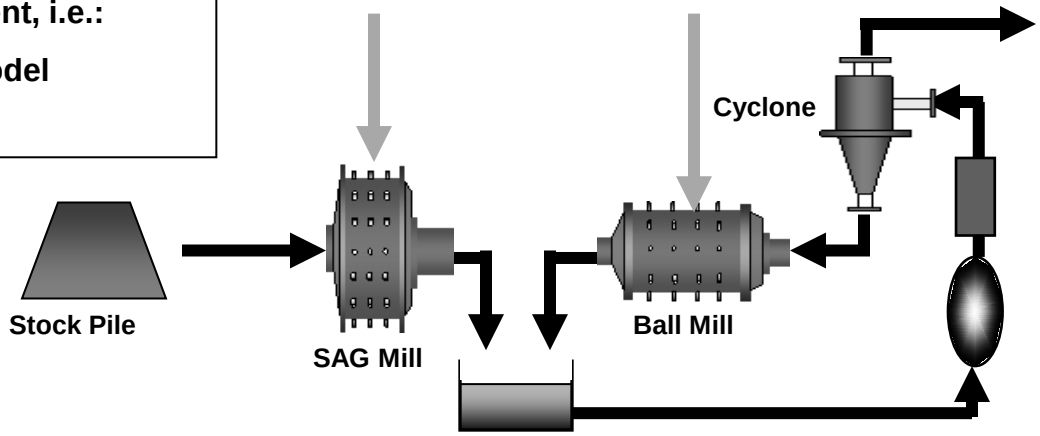


Grind Circuit Control Strategies

Estimated grind sized based on the incoming ore, historical performance, and plant conditions

Control Strategies that rely on indirect measurement, i.e.:

- Hydrocyclone model
- Virtual sensors



Particle size based on a sampled flotation stream processed through the lab - turnaround time not adequate for real time control

OR

Consolidated cyclone overflow sampled and processed through a PSA or PSM with poor availability

OR

Quick wet sieve grab samples

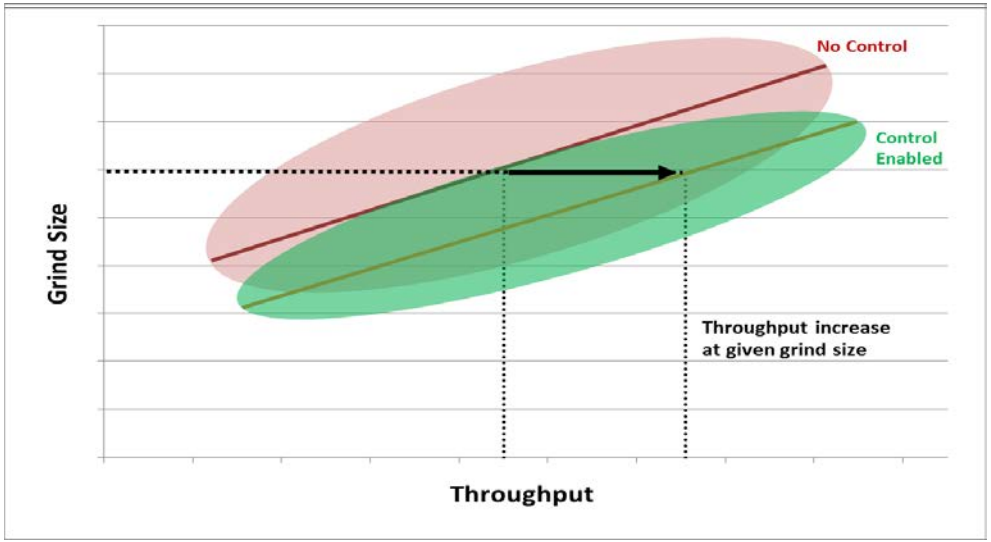
Sustainable Grind Circuit Control

Requires Particle Size Measurement

- Real time
- Full stream analysis
- Reliable and repeatable
- Provide 100% availability
- Low Maintenance

Enables Throughput-Particle Size Trade Offs

- Improved efficiency with control enabled
- Maximize recovery (by lowering particle size) for a given throughput range
- Maximize throughput for a given particle size range

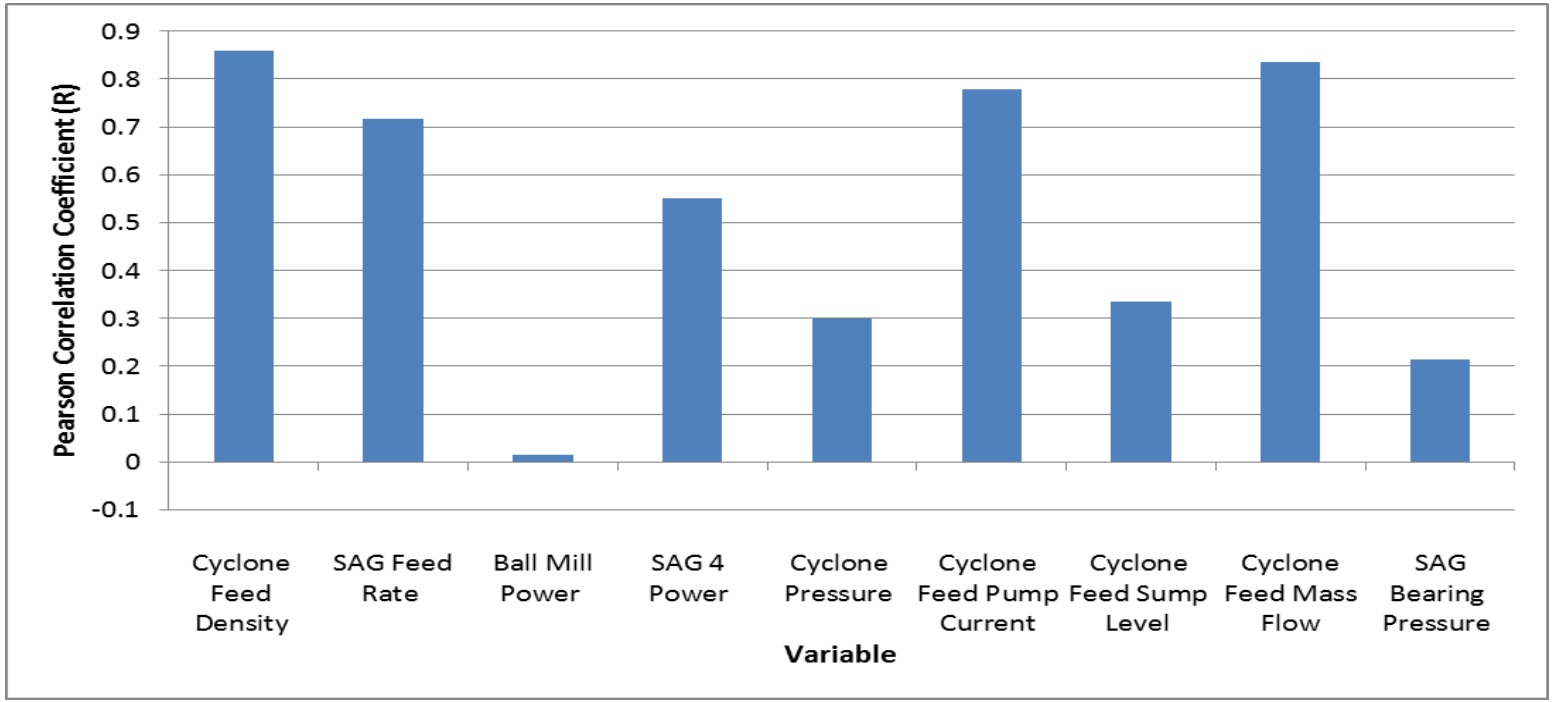


CYCLONEtrac PST Commissioning

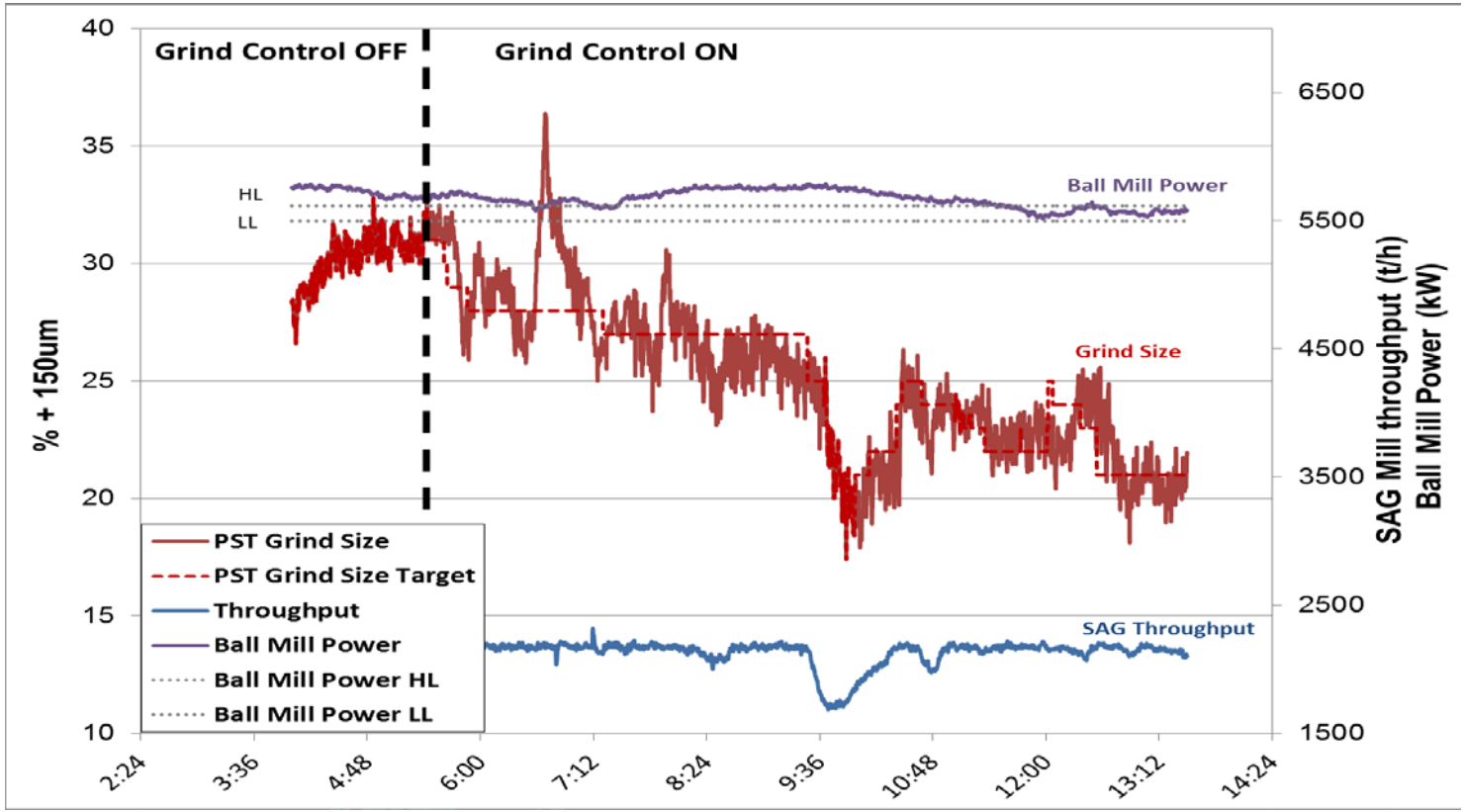
Initially installed on one cluster

Individual cyclone overflow sampling for validation /calibration campaign

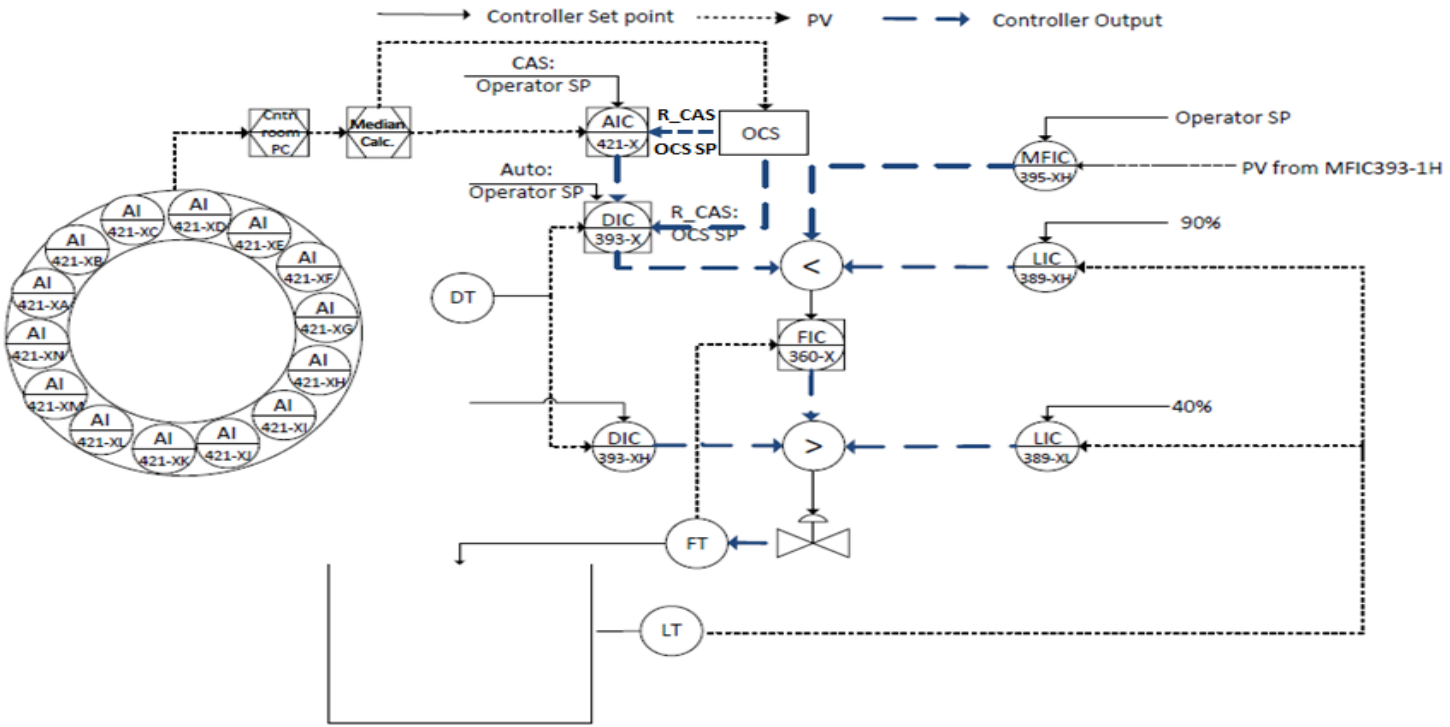
Control Development



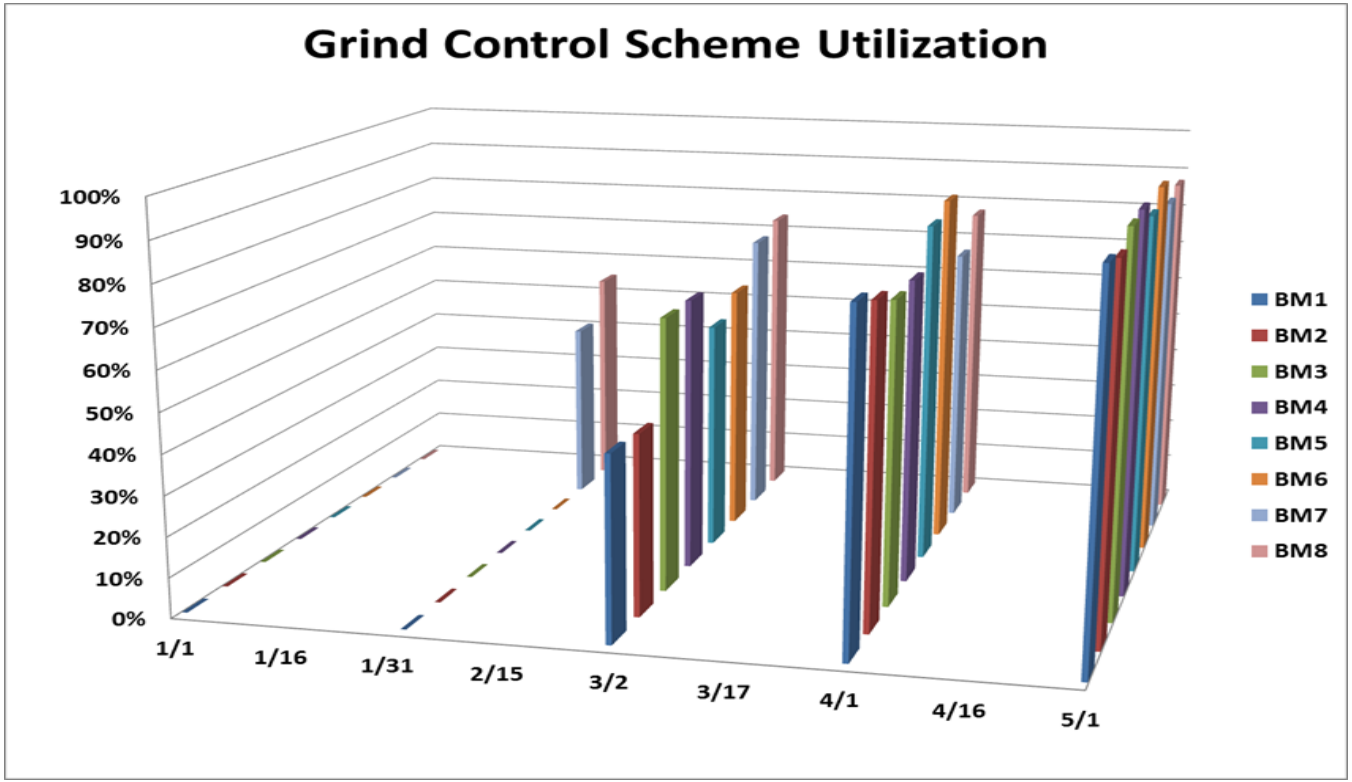
Testing multiple constraint control



Control Architecture



Plant wide control adoption



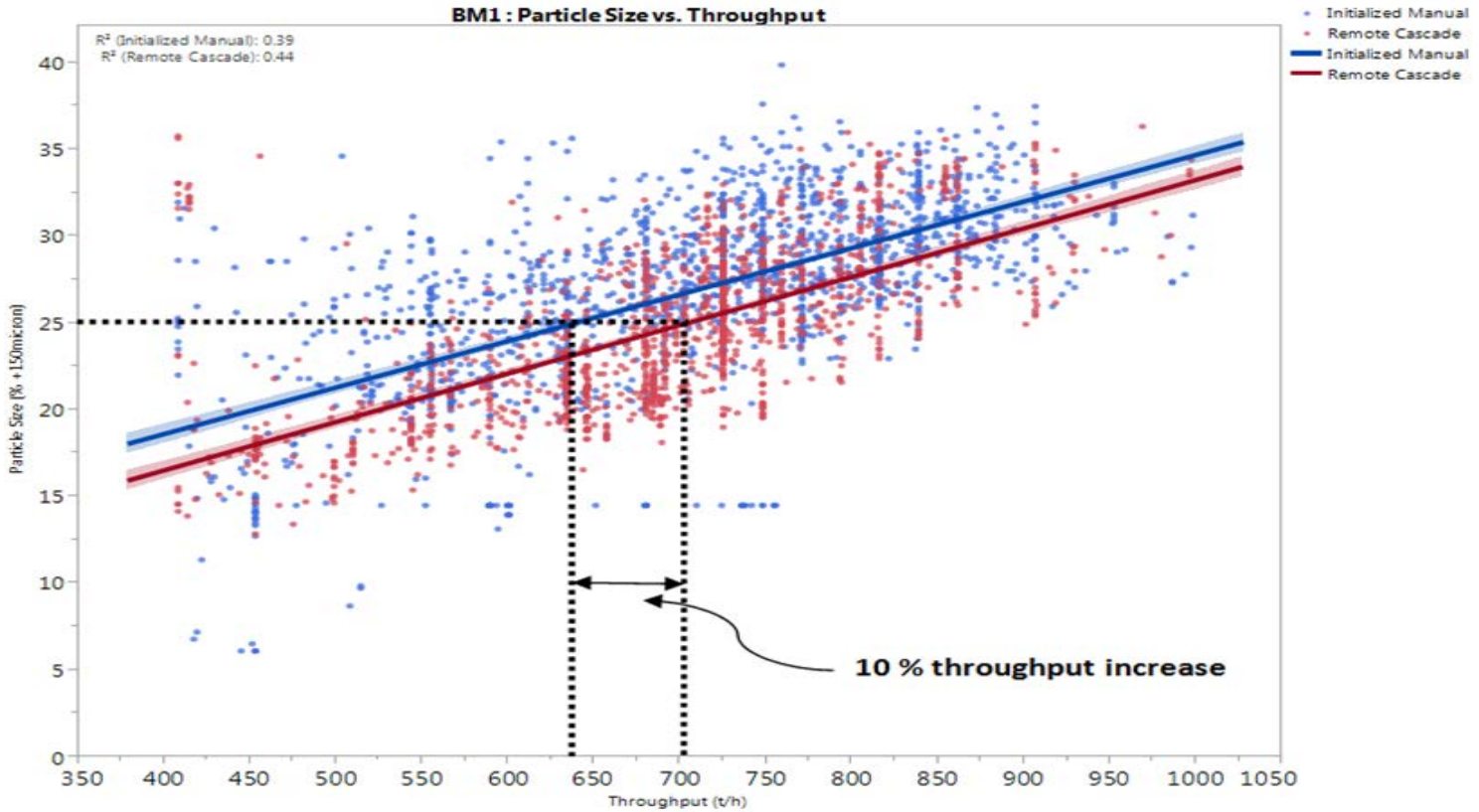
Results

- Final plant control strategy is **NOT** to hold a constant particle size product from the cyclones but to keep within an acceptable range (20 to 35 percent above 150 micron).

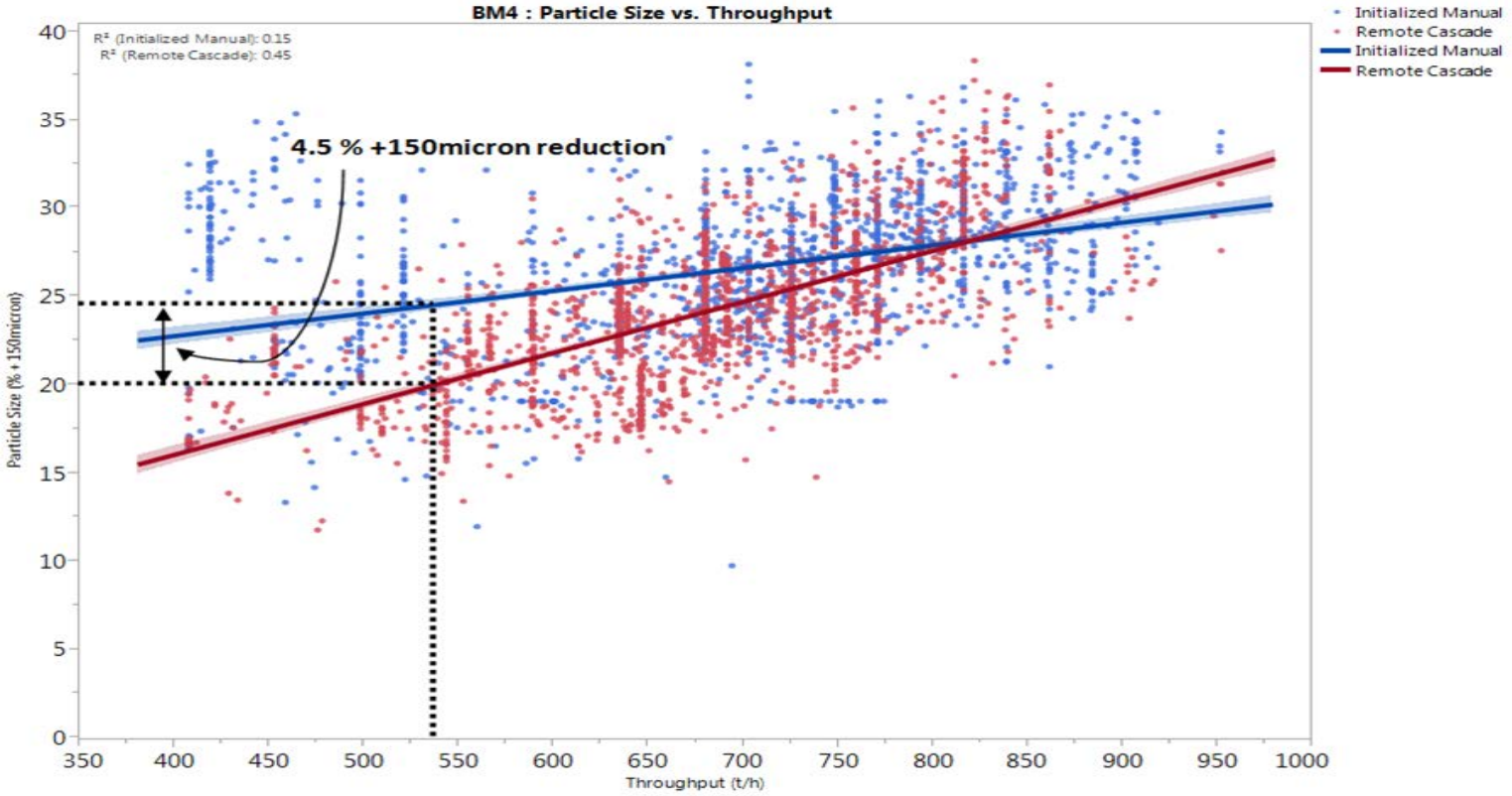
- Therefore analysing the control impact is more complex than identifying a specific particle size distribution or variance.

- By looking at the relationship between throughput and particle size, the performance by control mode of each milling circuit can be examined.

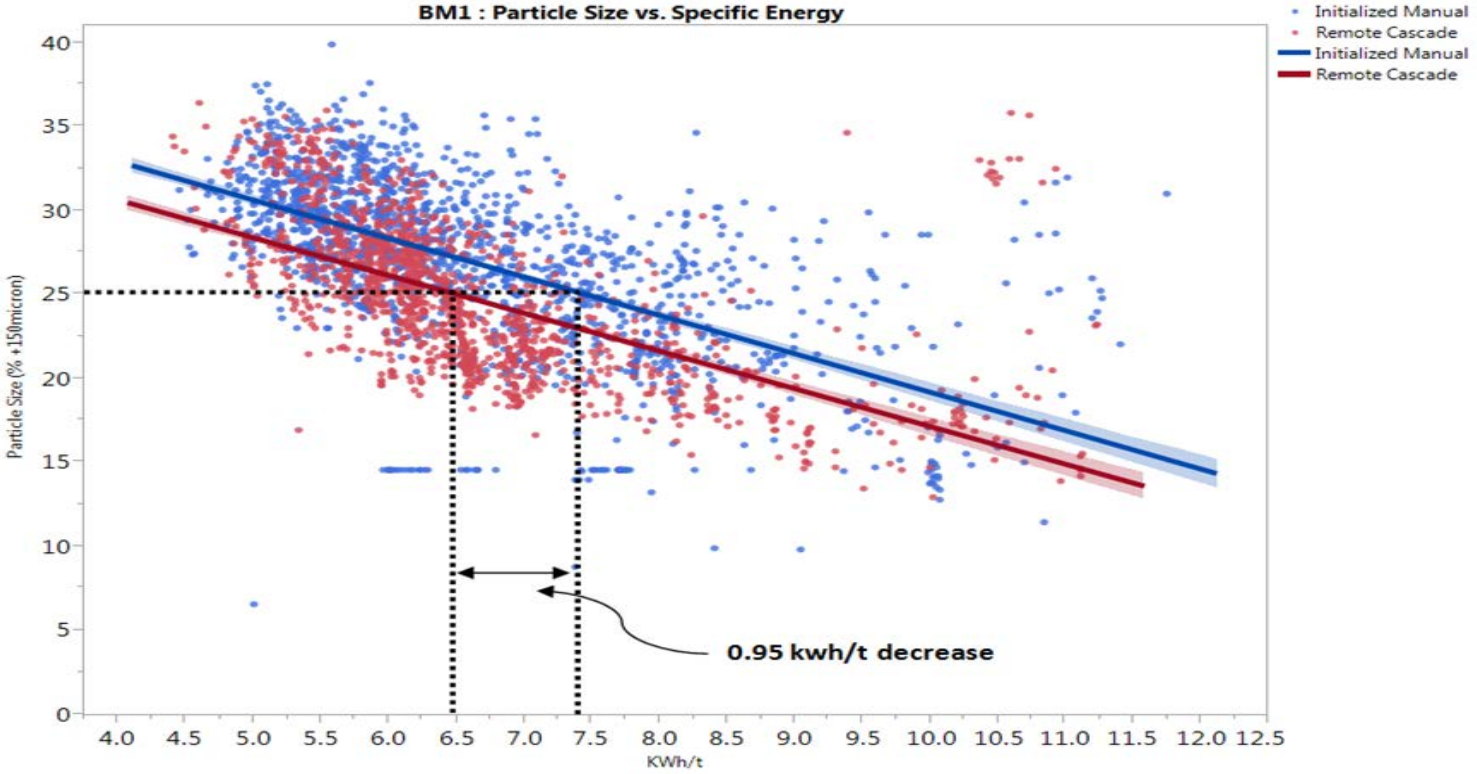
Results


BM1 : Particle Size vs. Throughput
R² (Initialized Manual): 0.39
R² (Remote Cascade): 0.44
Initialized Manual
Remote Cascade
Initialized Manual
Remote Cascade
Particle Size (% +150micron)
Throughput (t/h)
10 % throughput increase

Results


BM4 : Particle Size vs. Throughput
R² (Initialized Manual): 0.15
R² (Remote Cascade): 0.45
4.5 % +150micron reduction
Initialized Manual
Remote Cascade
Initialized Manual
Remote Cascade
Particle Size (% +150micron)
Throughput (t/h)
0
5
10
15
20
25
30
35
40
350
400
450
500
550
600
650
700
750
800
850
900
950
1000

Results


BM1 : Particle Size vs. Specific Energy
Initialized Manual
Remote Cascade
Initialized Manual
Remote Cascade
Particle Size (% +150micron)
KWh/t
0.95 kwh/t decrease

Conclusions

- Rio Tinto Kennecott has implemented a new control strategy in the ball mill circuit using new particle size measurement technology.

- Plant data has shown the following performance improvements:
  - **10 percent higher throughput** at the same particle size
  - **4.5% over 150 micron lower** particle size at same throughput
  - **0.95 kwh/t reduction** in specific energy consumption at the same particle size

Thank You

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