
mipac
A practical guide
to SAG Mill
Management

Grinding efficiency through control

In the heart of any mineral processing plant lies the SAG mill, a workhorse responsible for reducing large rocks into finer particles. Optimising its performance is crucial for efficient and cost-effective production. This article delves into the world of SAG mill management, exploring its importance and the various techniques employed to achieve peak grinding efficiency.

What is SAG Mill management?

A SAG (Semi-Autogenous Grinding) mill is a giant rotating cylinder filled with grinding media and the ore being reduced. As the mill rotates, the grinding media lifts and the impact crushes the feed material.

SAG mill control refers to the practice of managing the mill load, which is the amount of material inside the mill at any given time. Maintaining the optimal mill load is paramount for achieving the following:

- **High throughput:** Consistent mill load ensures a maximised amount of material being processed, maximising production rates.
- **Consistent product size:** A stable mill load translates to a consistent product with the desired particle size distribution, crucial for downstream processes like flotation.
- **Energy efficiency:** Overloading or underloading the mill leads to wasted energy. Proper control ensures the mill operates at its peak efficiency.
- **Minimised wear and tear:** Excessive load reduces the life of the mill's internal components like liners and lifters, accelerating wear and tear. Effective control extends equipment life and reduces maintenance costs.

The importance of measurement

The cornerstone of effective SAG mill control lies in accurately measuring the mill load. There are two primary methods:

- **Direct measurement:**
  This method utilises load cells positioned beneath the mill to directly measure the weight of the material inside. It offers the most accurate measurement but requires significant upfront investment.
- **Indirect measurement:**
  A more common approach if direct measurement isn't installed is to measure the bearing oil pressure. As the mill load increases, the pressure on the mill's bearings rises. While not as precise as load cells, it provides a reliable and cost-effective way to estimate mill load.

Controlling the grind: manipulating the variables

Once the mill load is measured, operators can adjust various factors to achieve the desired level:

- **Feed rate:**
  This refers to the amount of ore entering the mill. Increasing the feed rate raises the mill load, while decreasing it lowers it.
- **Mill speed:**
  The rotational speed of the mill significantly impacts the grinding action. The correct speed to maximise throw to toe leads to greater grinding force and a higher mill load.
- **Water Addition:**
  The amount of water in the mill affects the discharge density and recirculating load, maintaining the tonnage /water ratio correct for the ore type being processed will achieve an optimal grind, with enough water to flush the fines out of the mill without pooling inside the mill.

By manipulating these variables in response to real-time load readings, operators can maintain a stable and optimal grinding environment within the SAG mill.

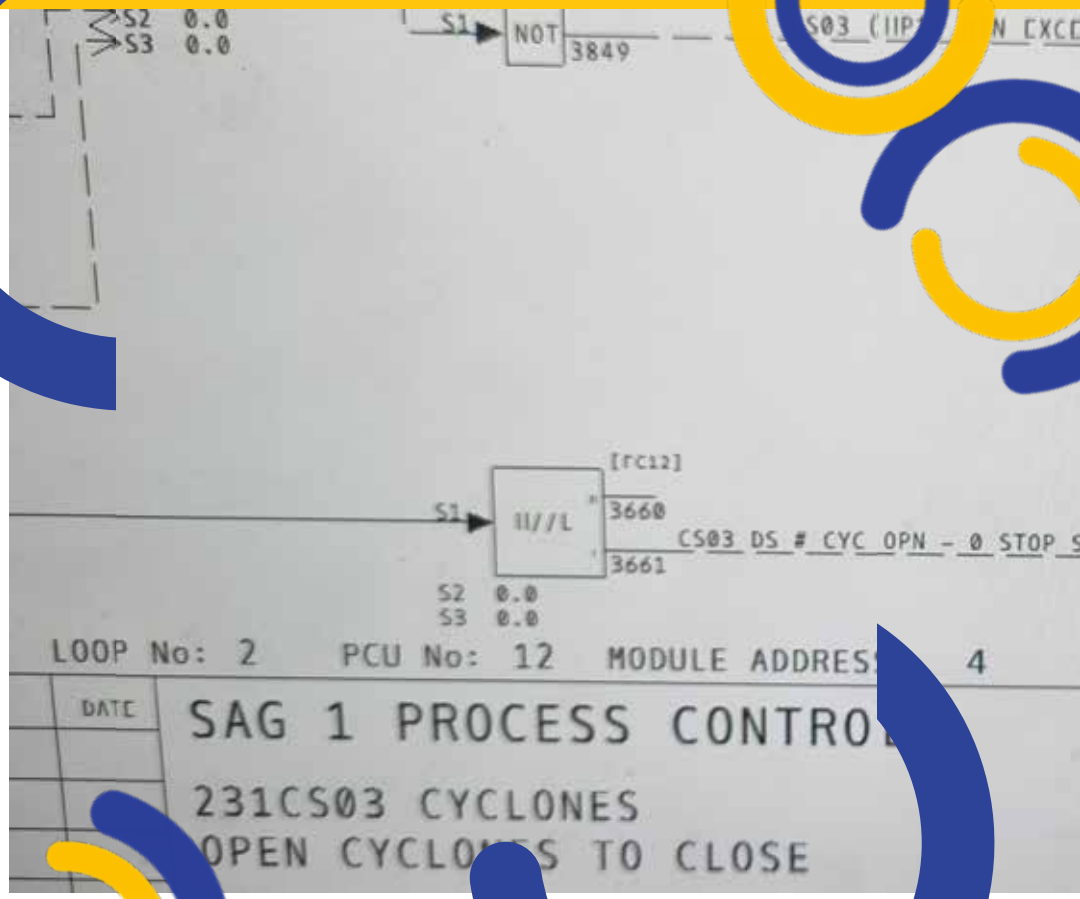
Is your SAG Mill underperforming?

While Semi-Autogenous Grinding (SAG) reigns supreme in mineral processing, many SAG mills aren't reaching their full potential. This is a significant concern, as primary grinding consumes the lions share of operational costs and directly impacts downstream processes like flotation.

The good news? Effective SAG mill control offers a powerful solution. By keeping the mill load (the amount of material inside) in the sweet spot, you can:

- **Boost throughput:**
  Consistent mill load translates to a optimised flow of processed material, maximising production rates.
- **Protect your mill internals:**
  Excessive load puts undue stress on liners and lifters, accelerating wear and tear. Proper control extends equipment life and reduces maintenance costs.
- **Optimise downstream recovery:**
  Stable mill load translates to consistent product size, a crucial factor for achieving maximum recovery in flotation.

The best part? Well-designed and implemented SAG control systems are readily achievable on most modern PLC or DCS platforms, delivering significant payback within weeks, not years.



Achieving peak performance: the control advantage

SAG mill control boils down to managing the mill load (and power) and the density of the slurry being processed. This can be effectively achieved using advanced regulatory control techniques. These techniques go beyond simple adjustments and leverage real-time data to optimise mill performance and unlock its full potential.

Taking control to the next level: advanced techniques

While the methods discussed above form the foundation of SAG mill control, advancements in technology have opened doors to even more sophisticated approaches:

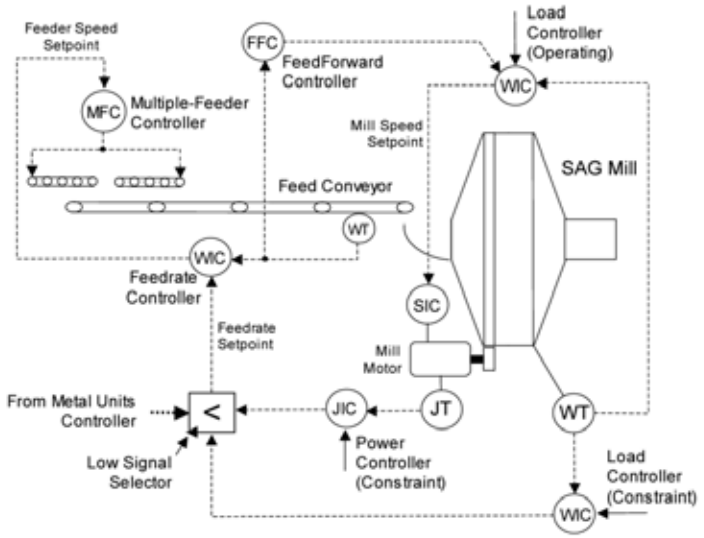
- **Model Predictive Control (MPC):**
  This technique utilises a mathematical model of the SAG mill process to predict its future behaviour based on real-time data. The MPC system then automatically adjusts control variables like feed rate and mill speed to optimise mill performance and achieve specific production targets.
- **Advanced Process Control (APC):**
  Advances in ML, Neural Networks and AI are now being applied to SAG mill control. With advanced abilities of being able to define the model and re-tune the models with current data. It controls all of the manipulated variables of the mill and represents a toolbox of statistical tools rather than the single MPC model.

Important to note is that these advanced methods still require the base layer of instrumentation and automation to be able to function.

The road to success: putting it all together

Effective SAG mill control is a blend of art and science. Understanding the principles, utilising appropriate measurement techniques, and skilfully manipulating the control variables are all crucial for success.

For processing plants seeking to maximise grinding efficiency and minimise costs, investing in robust control systems and potentially exploring advanced techniques like APC can yield significant benefits.



Typical DCS Based Control Strategy

The Mipac approach

Mipac has successfully optimised SAG mill control on fixed and variable speed mills in closed and open-circuit applications.

Our approach is:

- **Cost-effective**
  Existing control infrastructure is used.
- **Robust**
  No need for extra computer hardware, software or network connections.
- **Maintainable**
  Local plant personnel can provide day-to-day maintenance and support.
- **Appropriate**
  Directly meets the client's real control requirements.
- **Flexible**
  Can address other control issues, not just SAG Mills.

SAG Mill Managment: FAQs and Myths

Why can SAG Mill control be difficult?

The main reasons are often poor lower level control loops (particularly feedrate control); inappropriate tuning (particularly slow integrating loops); lack of and/or underperforming instrumentation; lack of metallurgical input.

Can my PLC or DCS be used for SAG Mill control?

Yes, without doubt. Most modern PLCs and DCSs have a sufficiently rich library of control blocks to build effective SAG Mill control strategies. We have experience with a number of suitable PLC/DCS systems which can be used.

Is a DCS/PLC more cost effective than an expert system?

Yes, provided your control objectives are primarily concerned with mill load and density stabilisation, however if process optimisation is included (e.g. operating at the optimal load) then a rule-based expert system should be considered.

Can a SAG Mill bec Controlled 100% on automatic?

While the latest new system can operate in a fully automatic approach, in most existing systems, the operator is still required. Operator input should always be encouraged. How long will it take to implement a typical system? With good instrumentation, 5 – 10 days on site.

Can a typical plant instrumentation person keep the system going?

Yes, if they are correctly trained. Mipac can supply this training.

Can the system be monitored remotely?

Yes, we can discuss your requirements.

What should I do prior to installation of a MIPAC SAG Mill control system?

The most important thing is to have a clear set of control objectives (e.g. stabilise mill load to a setpoint with an upper constraint power). Next ensure all instrumentation is well maintained and calibrated. Finally, appoint a metallurgical champion who will act as the plant representative (this is very important).

Is a Process Control Audit required prior to Implementation of SAG Mill Control?

Yes. An audit identifies control objectives, substandard instrumentation, and poorly performing control loops.

Grinding efficiency without guesswork

SAG mill control isn't just about keeping the load stable: it's about unlocking throughput, protecting equipment, and setting the stage for downstream recovery.

But success takes more than instrumentation. It demands clear control objectives, reliable measurements, and a strategy that balances automation with operator insight.

If your mill isn't performing at its peak, start by asking: what's holding it back? What variables can be tuned? And how do we build a control system that delivers results—day in, day out?

Need help defining your control strategy or auditing your current setup?

Reach out to Mipac's SAG Mill Control Team to explore your options.

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