**MET GRINDING SOLUTION**

SGS’ advanced systems expertise can help you to be more successful by developing and implementing technology-enabled solutions. Our proven project methodology is designed to extract best operating practices from your personnel, program it for automatic decision making and combine it with our in-house expertise. The resulting body of knowledge is then coded and deployed using our proven software platform, MET. Our approach brings understanding, consensus and a sense of ownership as the deployed solution demonstrates positive results.

**MET GRINDING SOLUTION**

Grinding circuits are arguably the most critical unit process in most process flowsheets. They often determine the overall plant throughput, and the product quality has a direct effect on downstream processing efficiencies and recoveries. Grinding behavior is a function of the ore characteristics of the feed as well as the mill configuration (liners, grates). As a result, the optimal operating point tends to change with the feed and over time. High turnover in operating staff also results in a reduction in operating skills. Inexperienced operators will tend to operate a mill in the “safe” and suboptimal operating region, resulting in lower throughput, or – in some cases – can run a mill into an overload.

SGS offers the MET (Modular Expert Technology) Platform, which consists of a set of tools that support the easy and rapid development, commissioning and tuning of expert systems and advanced control applications.

The MET Grinding Solution is specifically designed for the stabilization and optimization of grinding circuits. It integrates into the overall control hierarchy by utilizing and enhancing the regulatory control layer of MET to optimize operational performance.

**BENEFITS**

The overall benefits of the MET Grinding Solution include:

- Increased throughput and improved circuit stability
- Improved overall process performance, reliability and quality through process stabilization and optimization
- Coding knowledge of best operation practices, allowing for consistent operations and decision
- Reduced variability of critical process variables
- Minimized production costs through optimal use of manipulated variables.
- Minimized negative effect of process disturbances
- Improved downstream recovery through improved product particle size control
- Reduction of undesirable operation such as mill overloads or liner damage
- Minimized loss of product to waste streams
- 24x7 operation with online process tuning requiring no downtime
- Short payback periods

**TECHNICAL FEATURES**

**PROCESS OPTIMISATION AND STABILIZATION**

A typical grinding solution implementation utilises fuzzy logic rules to control the operation of the grinding circuit in terms of the selected controlled variables, in most cases the mill power and load. The goal of the strategy is to first stabilize the operation, followed by optimization to maximize by pushing throughput while maintaining acceptable operating limits.

Once the overall variability of the process has been reduced, the control system will be able to “push harder” against process constraints and to seek optimal grinding conditions, ensuring the long term optimisation of the process. The fuzzy logic controller implements the control strategy through the manipulation of setpoints commonly utilised by operators to control the circuit. This can include the mill feed rate, inlet water dilution and possibly the mill speed.
BEST OPERATING PRACTICES
Because grinding circuits are highly nonlinear and behavior varies over time and with different feed ore types, they are difficult to control using traditional regulatory methods alone as well as traditional predictive controllers. Robust control of grinding circuits can best be achieved and consistently maintained through the integration of a suitable control platform which not only integrates advanced multivariable process control techniques but also captures human knowledge and experience. A basic template of fuzzy logic rules is based on the combined experience within SGS and best practice control strategies for grinding circuits. This template is used as a starting point in the design of the logic for a site, and is adjusted and changed according to site specific goals and requirements.

HYBRID CONTROL
Control of grinding operations can be further enhanced with Model Predictive Control (MPC). SGS’ approach is to couple fuzzy and MPC into a hybrid control strategy that leverages the strengths of both approaches.

When the controlled variable is outside the range in which the MPC was trained, fuzzy logic will be activated to push the controlled variable to its optimum region where MPC can regulate the response and stabilize it to the desired setpoint(s). Once stabilization is achieved, the target process value (PV) can be driven to higher limits, to an optimum or closer to constraints (Graph 1).

OVERALL CIRCUIT PERFORMANCE IMPROVEMENTS
The standard MET solution is built on fuzzy rule-based logic. The standard solution can also be augmented with other advanced techniques including model-based predictive control, smart sensor validation using neural networks, and custom rules for fault detection and analysis. The modular nature of the MET toolkit allows for the seamless integration of the various grinding control cartridges providing a robust solution resulting in a circuit with:
- Increased throughput.
- Reduced variability.
- Improved response to disturbances.
- Improved product particle size for downstream recovery.

TECHNICAL ACHIEVEMENT
The MET Grinding Solution has been successfully implemented at numerous sites across the world, where it has proven itself as a valuable tool in achieving improved production throughput and operational stability.

This can best be illustrated by actual operational results where the installation of an expert system on a SAG mill has resulted in a 6% improvement in throughput in addition to an overall reduction in the variability of power and load (Table 1). The improvement in stability of the mill load is best illustrated graphically, indicating not only a lower variability, but also a significant reduction of mill overload events (Graph 2).

<table>
<thead>
<tr>
<th></th>
<th>LOAD (T)</th>
<th>POWER (KW)</th>
<th>FEED-SP (TPH)</th>
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<td>9715</td>
<td>1627</td>
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<tr>
<td>Offline Average</td>
<td>502</td>
<td>9504</td>
<td>1538</td>
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<tr>
<td>% Improvement</td>
<td>3%</td>
<td>2%</td>
<td>6%</td>
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<tr>
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<td>1631</td>
<td>729</td>
</tr>
<tr>
<td>% Improvement</td>
<td>28%</td>
<td>-40%</td>
<td>-44%</td>
</tr>
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Table 1
**MET SOLUTION APPROACH**

The successful completion of a control system implementation rests on the effective integration of three essential core capabilities:

- Mineral processing.
- Process control.
- Project management expertise.

The standard approach taken during a grinding system implementation depends on the achievement of the following long term objectives:

- Ensuring that initial system benefits are achieved and then utilised for continued performance gain
- Long term site acceptance and ownership of the system.

The success of any advanced control system lies in the continued utilization of the system, which is primarily a function of its overall acceptance by the end users. Long term acceptance can only be achieved by ensuring ownership by the users and the personnel maintaining the system.

SGS’ approach to project integration is an operations centric approach, where the key to success lies in the inclusion of production and technical personnel during all stages of the project, contributing to the long term success of the application.

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**THE MET PLATFORM**

The MET Grinding Solution is developed using the MET platform, a development environment which allows for the creation and deployment of real-time, mission critical expert solutions. The MET platform consists of a set of tools to support the easy and rapid development, commissioning and tuning of expert systems and advanced control applications interfaced with external systems including DCSs, PLCs, and databases.

Key features include:

- Open/graphical logical structure using logic containers where the overall control strategy and logic are open
and easy to understand by the end user and modifications to logic are easily implemented

- Powerful presentation of schematics, control logic, animation of logic blocks, data connections, and graphical features such as graphs, charts, tables, alarm queues
- A wide collection of process objects, data processing, and development support libraries. Real-time modification where new logic can be added and implemented online, without recompilation or shutdown
- Data recording where data can be recorded with a predetermined interval and later used for plant analysis and surveys
- Data replay where it is also possible to record real-time data (OPC variables) and later play it back
- Reliable data communications including redundancy, diagnostics and monitoring
- Innovative custom solutions based on expert systems technology

MET SUPPORT

SGS offers the most complete support service for our applications to ensure maximum long term returns from your expert system application. The support subscriptions combine on-site and remote assistance according your specific needs.

The SGS support service assures your company that the value added through the implementation of the SGS expert system will be consolidated and enhanced over the years.

With over 11 years of demonstrated results, SGS has more installed and operating expert systems than any other company in the world. Contact us today to find out how our advanced process control solutions can provide you with the decision making tools to streamline your production in real time.

CONTACT INFORMATION

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