

Quality management and machine automation in material-handling plants

Achieving the Right Quality Mix

MINING ^

Customers in the mining and metals industry have ever-increasing expectations for the punctual delivery of material in the required quantity and defined quality. In order to meet these demands, material-handling operations require a system capable of capturing all process, quality and grade information – and one that can correlate the data to the physical position of the product as it passes through the plant.

The answer from Siemens is Simine^{CIS} MAQ, a comprehensive material-monitoring system that allows for straightforward quality planning and material blending. The solution covers the entire process chain, from incoming material, e.g., via a mine or train, to the storage area, and delivers precise 3-D visualization of the stockpile and its composition. The operator is kept informed of the current flow of material and the current material qualities/grades in the stockyard at all times. User-friendly HMI design based on graphical screens and 2-D and 3-D stockpile models greatly simplifies material-dispatch operation. Together with Simine^{CIS} MOM (the fully-automatic machine-operation module for stockyard machines) contractual requirements are guaranteed to be met. Furthermore, this combination increases the efficiency of the entire materials-handling plant.

The modular structure of Simine^{CIS} MAQ means that it can be flexibly adapted to plant conditions and the conveying process. Depending on the specific plant configuration, different standard modules can be installed, such as:

- Data Import Interface (e.g., for material received from a mine, barge or train)
- Configurable Material Tracking with an online link to the control system
- 3-D stockpile management
- Data Export Interface (e.g., for material going to the power plant, barge or train)

The Material Tracking module, which is the core module in Simine^{CIS} MAQ, maps out the entire material flow from material input to delivery. All other modules also have interfaces for transfer of material data (e.g., train unloading, reclaiming from pile and train

loading). Depending on process requirements, the material data held in the system are adapted to meet the specific requirements. All relevant data are listed in a configurable material-data record. In addition to the quality data, a material-data record also contains quantity information and a time stamp.

The right quality each time

The stockpile-management module integrates data from the stockpiles and bins into the material flow. Its central function is to represent the stockpile's contour and quality based on online process values. The derived stockpile structure is stored in the database with information for each cubic meter in regard to quantity and quality. It is updated online each time the stockpile is changed.

The latest stockpile contour and material data stored in the database can be visualized in different forms. Along with a 3-D model of the stockpile (see Figure 1), a compressed 2-D stockpile model is also available. In addition to mapping the surface contour, different material classes or material types are displayed in different colors.

A central function of quality-planning support is the early planning of blend qualities. Using the virtual grid, it is possible to select zones for which the system then directly calculates the resulting blend quality. This enables the resulting quality parameters to be established for the material before it is actually removed from the stockpile.

To define a blending job, the relevant zone has to be selected in each bin. The calculated resulting quality and the total quantity of both zones are immediately displayed in the lower area of the display in tabular >>



The bucket wheel stacker/reclaimer can be automated on the basis of a high resolution computer model.

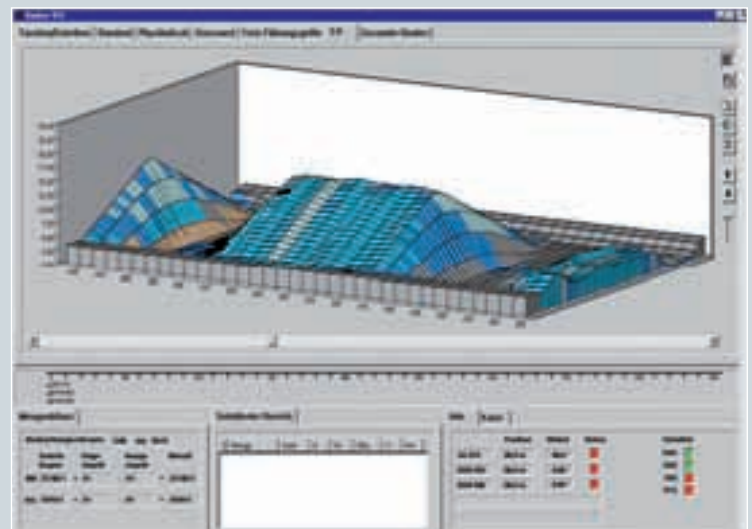


Fig. 1: 3-D stockpile image; different colors signify different materials



Simine^{CIS} MAQ monitors the material flow from excavation to transportation and further processing.

>> form. The required blend result for quantity and quality can be optimized by moving the relevant virtual grids.

Fully automatic blending process

The blending process is precisely where fully automatic operation of Simine^{CIS} MAQ comes in. This package ensures simplified material quality and quantity management in bulk-handling facilities. All quality parameters and the calculated material classification from the blending module are directly transformed into job orders for the reclaimers. The material-transport process can then be executed with the highest efficiency and accuracy.

An updated 3-D model of the stockpile enables the safe operation of driverless bucket-wheel machinery by knowing the exact position of the bucket wheel in relation to the stockpile. This helps avoid potential damage to the bucket wheel and its support structure through uncontrolled contact with the stockpile. The 3-D model also achieves the optimal flow of bulk material through exact positioning of the bucket wheel during excavation.

A fast and precise semiconductor laser scanner acts as a sensor, which is mounted on the boom arm for positioning over the bulk material. Exact determination of the scanner position, described through locations and angles, is done by absolute rotary-position encoders with a high resolution. The encoders are

connected to the PLC in the electrical cabinet of the machine. Within the PLC, the angular degrees of the boom and the lifting equipment, as well as the distance covered by the machine chassis, are calculated and sent, together with the scanned values, to the PLC for further processing.

Advanced software in the PLC provides both open-loop and closed-loop control of the bucket-wheel machine. For unmanned operations in particular, a software package was developed that handles communication with the quality-management system Simine^{CIS} MAQ in order to get the exact contour for the reclaiming process and to keep the shape model of the stockpile updated during stacking and reclaiming.

Easy integration into other systems

The system's modular setup allows the design of tailor-made solutions to meet the needs of the customers, enabling seamless integration from operations all the way up to management. All solutions are based on ISA 95, which allows them to be scaled up to a Manufacturing Execution System (MES). Below are some examples of available standard functions:

- Production Order Management integrates the planning and scheduling functions. Both optimize interactively the transport and storage of raw materials and maximize the effectiveness of operations.
- Data Integration Service links all relevant Enterprise Resource Planning (ERP) data to the operating units and gives feedback about the status of the production back to the ERP system.
- Product Tracking & Tracing follows up orders during storage and transport and traces the origin of raw materials up to the finished product (product genealogy).
- Process Information Management System consolidates all process and production data on a real-time basis, over periods of years.

Benefits

The quality-management system combined with the automatic machine-operation module is a well-proven system that can be adapted for various types of bulk-material-handling plants (e.g., stockyard systems for power plants, harbors and mines). It makes production planning straightforward and offers maximum transparency. The investment cost for the system is kept low due to the extensive use of standard components. ■

Author
Karl-Heinz Gerlach
Contact
mining@siemens.com