Optimizing Energy and Operations for Cement Production

Lehigh Cement Company's modernization of its Union Bridge, MD, plant has integrated process control and energy management to improve process efficiencies across the facility.

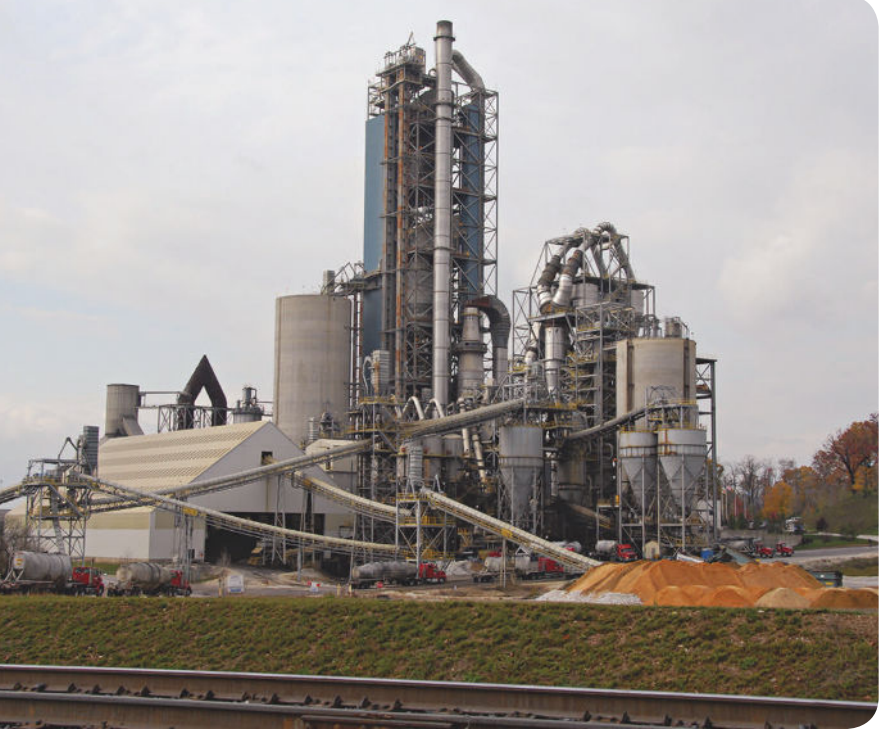
Iltaf Khan
Lehigh Cement
Moin Shaikh
Siemens Process Automation Systems

Over the years, Lehigh Cement has been willing to try innovative approaches to optimize energy consumption and improve operational efficiency. The company has sought to eliminate islands of automation, integrated its software platform under one centralized location, and even transferred production data into SAP enterprise system as part of its efforts. This thinking challenges the notion that PLC/HMI-based controls are the only cost-effective method for cement producers to improve the efficiency of their operation. Integrated process automation systems are being designed to meet, and many times exceed, the specific requirements of the cement industry, particularly for those with an objective to optimize energy consumption, improve control system longevity, and ultimately reduce the total cost of operation over the life of the system.

Lehigh Cement Co. is a division of the Heidelberg Cement Group, the third largest cement producer in the world. In the first quarter of 2008 company employed more than 65,000 people globally and produced 19.6 million tons of clinker and cement. The company also produced 61.0 million tons of aggregates and 10.0 million tons of ready-mixed concrete from its manufacturing operations.

Lehigh's modernization connected those islands, the multiple PLC/HMI-based systems throughout the facility. Plant managers wanted to lower labor and operational costs using a process control system that could control and monitor everything from a centralized location, but meeting this requirement was no small task.

Following precedents set by other Heidelberg plants around the world, Union Bridge chose to standardize its automation platform



Cement plants are a combination of several process sub-sections combined to form continuous processes. Typically, OEMs supply mechanical equipment packages with their own controls that perform specific functions within the sub-sections. These sub-controls are an integral part of the process and need to take commands from the main plant control system and report status and messages. Source: Siemens

with Simatic PCS 7 and the Cemat application library from Siemens. This system provides extensive diagnostic capabilities for individual objects such as motors, valves, and dampers that can be used consistently across the whole plant and beyond. An operator trained on one section of the plant can easily learn the operations of a new plant area or even the operations in a different plant across the Lehigh organization. This allows managers to redeploy operators to areas that need the most attention within the plant or even to other Lehigh manufacturing facilities.

Open system flexibility

The new system controls all sections of the plant, including raw material processing, preheater and kiln, clinker grinding, packaging, and storage. This includes 17,600 active I/O points and 3,000 more still being installed.

The Cemat application library consists of pre-engineered function blocks, faceplates, and operator graphics designed for full operation of a cement plant. It delivers a uniform flow of data from mining of raw materials through finished product with a high level of transparency. Integrating process optimization software packages from various vendors allows the system to easily add on controls for processes like mill optimization, kiln shell scanner, quality control, and a kiln control system database.

The application library can help operators see the larger plant picture since so many of the operations are built into the system. Library operations include topics such as how to troubleshoot problems with minimal downtime, and how to interlock the drives, dampers, belt conveyors, and analog measurements throughout the plant. This allows best operating practices to be shared across Lehigh's organization without making operators re-learn the basic operation philosophy or the functionality of the individual objects such as motors and dampers.

Functionality embedded in the blocks is based on years of on-site experience, so engineering is simplified and reliable. This allows operators to focus on process interlocking that

Self-serve loading

One very interesting function built into the facility by the Lehigh engineering team, is an automatic load positioning system at the plant's day silos for loading cement into trucks. The driver simply parks the bulk cement truck on a scale located under one of the six company loading lanes, then walks over to a card-scanning terminal and scans a pre-authorized magnetic card on a control panel to start the automated process.

Since this self-serve operation is directly linked to the cement plant's SAP system, which is integrated with PCS 7, the driver does not have to do anything but open the loading hatch and wait for the system to approve his order. Once the driver's card and order is approved, a vision system, using a Siemens VS 10 camera, scans the top of the truck, finds the top hatch, extends a bellows over the opening, and begins loading the cement automatically.

ONLINE

For more information, visit:

www.lehighcement.com

www.sea.siemens.com

Process sub-systems operating only with OEM provided controllers can become isolated very easily, leaving operators with a fragmented operational picture. Integrated control ties the whole plant together. Source: Siemens

is unique to the particular process that is being assigned. Fault finding is fast because of detailed fault messages that are grouped together in operational-specific areas or groups.

Power monitoring

Lehigh's integration of power monitoring information into the PCS 7 system has proven to be extremely beneficial. Given the high proportion of current used to run motors, any improvement can be very profitable. Lehigh has built its program around high-performance motors, adopting "smart" MCC (motor control center) technology, and tight integration of motors and drives into a process automation system.

Lehigh Cement uses this approach to lower energy consumption and cost throughout their manufacturing operations. The plant has a power monitoring system supported by a dedicated PCS 7 controller, with 218 power monitoring devices connected via Profibus. These devices have been installed on each of the MCCs and drives, providing real-time information about energy usage.

The power monitoring devices provide operators with a power consumption picture including amps, voltage, and the power factor sequencing in total numbers for each phase and current. With this capability, power consumption calculations and measurement for each area of the plant, even for each drive and motor, can be presented to the operators via the HMI. If an area is not running efficiently, operators will be able to see where the inefficiency is located and make adjustments accordingly. For example, if power consumption spikes or the plant's per ton power consumption increases, supervisors can now take immediate action.

In the past, Lehigh Cement placed power monitoring devices in only a few key areas throughout its processes that required manual recording. It would not be until the end of the month, after the data was compiled, that they would discover an energy consumption problem. Now, manual collection has been eliminated, and plant operators can act immediately to fix a problem based on real-time data.

Load shedding for profit

Because the system provides real-time information about power consumption in different sections of the plant, Lehigh can sell power back to the utility if it does not consume its full power quota required for the entire operation of the plant.

Many manufacturing plants buy power in bulk per month at a fixed price. Normal customers pay the market price for power which is calculated about every five minutes. If market consumption goes high at any time and the prevailing prices climb above Lehigh's contract price, it can sell some of its pre-purchased power back onto the open market at the higher rate for a profit. By having the ability to monitor its overall power consumption precisely, Lehigh knows exactly where it can shed load and sell power to the utility.

"Power consumption for each area of the plant is presented on the HMI. If an area is not running efficiently, operators will be able to see where the inefficiency is located and make adjustments accordingly."

The plant can also shed load selectively to avoid a complete plant shutdown in the event of problems on the local grid. In some emergency situations, the utility can request that the plant curtail its load immediately. Operators can review real-time data and decide which parts to shut off to accommodate the load reduction. With the PCS 7 system and power monitoring devices, this is a very quick process because the utility typically requires action within 10 minutes.

Results: 18% labor reduction

The modernization of the manufacturing processes and implementation of fully-integrated process controls has been critical in increasing production, while reducing energy consumption and labor hours.

In 2007, the plant produced in excess of 1.8 million metric tons of cement, a considerable increase over its pre-modernization cement production. Meanwhile, the energy consumption per ton has dropped. Similarly, plant clinker production has increased over the same period.

The islands of automation that existed in several areas throughout the site are now integrated into the PCS 7 Cemat platform under one centralized location. The plant's 40,000 sq. ft. core building houses all activities supporting the manufacturing process, which can be controlled through 12 consoles by just one operator if necessary. The modernization project resulted in an 18% reduction in labor hours.

The integration of its new process control system has allowed Lehigh to optimize its energy management and improve process efficiencies throughout its facility. The functionality and diagnostics are now consistently applied across the whole plant, increasing operability and streamlining plant cost of operation.

Reducing total operating costs of a cement plant can be achieved by streamlining its process controls and switching from a PLC/HMI-based format to one built on fully-integrated plant automation. For producers, it is not so much a question of whether or not plants will embrace this technology as it is an inevitability that plant economics will prove this is the way to go. Those facilities that do will be in a better position to accelerate market share and increase profit margins. **ce**

Iltaf Khan is systems manager for Lehigh Cement, Union Bridge Plant. Moin Shaikh is process automation systems marketing manager for Siemens Energy & Automation.