Ohio Lime Increases Quarry Productivity by Automating with PLC’s & InTouch™ MMI

WOODVILLE, OH — Most people probably don’t consider a mining company to be a likely candidate for automation systems. After all, the mechanical process of taking minerals out of the ground, transporting them in kilns and bagging product for shipment hasn’t seen much in the way of technological advancement in a lot of years. No real room for improvement there, right?

Don’t tell that to management at Ohio Lime Company. They’re one of the largest producers of calcined lime in the United States and they’ve just completed a massive project to automate the control of all their limestone quarry and processing operations. The new computer-based system has allowed them to make better use of their existing equipment and facilities, rather than having to invest in additional equipment and construction to increase production capacity. It is based on a network of three Modicon 984-485 programmable logic controllers (PLCs) that coordinate the interaction of all physical equipment.

The key to the success of the system is the man-machine interface program developed using the Windows-based InTouch MMI software from Wonderware. This program runs simultaneously on three IBM-compatible i486 computers located around the plant and allows operators to centrally monitor and control all plant operations from any of these sites. The end results are better use of existing operator staff and more efficient lime production.

Increased Product Demand

Ohio Lime produces more than 1.5 million tons of crushed or dehydrated lime
products each year at its 600 acre quarry and processing plant located southeast of Toledo. These are made by crushing limestone to specific sizes and burning it in a massive kiln. The stone is brought in from the quarry stockpile, via two quarter-mile long conveyor belts, to stone holding bins. Fine limestone powder and very small particles are screened out of the stock and dumped back over the quarry edge. The remaining rock is sent from the holding bins through an elevator to the pre-heater, where large hydraulic rams push it into the lime kiln.

The kiln is a long, cylindrical chamber that rotates nearly horizontally at a very slow speed. It is coal and natural gas fired to a temperature of 2,000°F and normal processing takes about four hours for the stone to move from one end to the other, being dehydrated as it moves slowly. Using coal to fire the kiln has the added advantage of putting a hard coating on the lime pebbles, which helps in subsequent handling operations. Once it has passed through the kiln, the lime is fed into a Niems cooler before being transferred to a handling system that either directly loads trucks or rail cars, or packages the Lime in bags, for shipment to customers.

The resulting pebble and flux products are used in a variety of markets. Their largest customers are steel companies, which use it in pebble form for purification of molten steel. Other customers use flux products for everything from extracting magnesium from salt water to making aspirin and antacids. In addition, the company produces dried (not burned) limestone for such uses as glass manufacture and fertilizer fillers.

All of these markets have been growing so well recently that Ohio Lime had a very basic decision to make earlier this year. They needed to be able to produce more product and they could do it in either of two ways: add new processing equipment to increase capacity or automate their existing facilities and make them more productive.

"The solution was really quiet obvious because it would be very expensive and take a lot more time to add new equipment than it would to enhance our existing systems," explained Bill McGinnis, chief electrician. "At the same time, the addition of the PLC network and the InTouch MMI gave us the benefits of centralized operation, sophisticated color graphics that replicated the real equipment in our plant, data trending, alarm printing and a multitude of other features that made operation of the plant much easier and more efficient."

**Six-Week Development Effort**

The entire upgrade project for the Ohio Lime plant was completed in less than six weeks, using engineering consultants from AVCA Corporation, in Sylvania, Ohio, and electrical contractors GEM Industrial, Inc. The InTouch software was sold by Microtek Controls, Inc., of Solon, Ohio. GEM installed the wiring for PLCs and discrete sensing devices throughout the plant. AVCA provided turnkey coordination and engineering, including developing the PLC program that controls all equipment and the MMI graphic screens. An important aspect of the project development was that existing operating methods and equipment identification numbers could be used in the new...
system so that minimal operator retraining was needed. In addition, the highly detailed, three-dimensional equipment images developed for the operator screens made computer use intuitive.

The opening screen for the Ohio Lime system shows every subsystem involved in lime production, from the silo feed system that brings the stone out of the quarry to the tailings separators, preheater rams, kiln, coal, gas handling, Niems cooler, lime handlers, product screening and classifying, and the dust collection systems.

“This one screen is valuable for operators because it’s the one place where they can get an overview of the entire operation — showing detailed replicas of all the physical equipment spread out over hundreds of acres of land,” McGinnis explained. “All of the PLC’s and associated ladder logic control the equipment via I/O signals from discrete physical devices such as limit switches, but the high quality screen graphics make it intuitively obvious to operators what equipment they’re looking at. At the click of a mouse, they can zoom in on the more detailed screen for any subsystem.

“For every system that has a control associated with it, we have a feed control capability,” he added. “Operators simply hit the start button and the PLC will do its automatic start sequence. All systems are tied together now and timing of all tasks is automatic so that the lime stone moves through the plant smoothly. This ‘buffering’ of production flow means that when silos get full, for example, conveyors will shut off until the downstream equipment has processed sufficient rock for the conveyors to turn back on.

“Through it all, operators can monitor what’s going on and can override automatic controls at any given time in order to respond to unusual occurrences of emergencies,” he said. “Real-time data is available to them on-screen, either directly or at the click of a ‘button’ which pops up a data screen that overlays on top of the operating screen. This same information can be used for diagnostic purposes so that we make more efficient use of our service technicians by equipping them to repair a problem before they go out on-site.

Two Major Systems

Like any other industrial operation, each subsystem in the facility is important to successful production — but some are more important than others. At Ohio Lime, these are the preheater, with its rams, and the kiln itself.

The stone coming from the quarry is usually about 12” x 0” x 6” in size and must be crushed to standard sizes such as 2” x 1” before it is put into the kiln. The preheater rams are single-cylinder hydraulic devices that cycle in and out to push the rock into the kiln. They operate at 2,700 to 3,000 pounds per square inch pressure and are powered by two hydraulic pumps. These alternate service in a standard lead/lag pattern so that wear is even between them, but one pump must be in operation any time the rams are in operation. Only one ram is stroked at a time. The cycle is set to rotate from #1 to #10 in a consistent pattern, so
that wear is even. A special sequence cycles
the corner rams twice per sequence to keep
the corners of the preheater clean.

“One really nice feature of this control system is
that we now know instantly when a ram is stuck,
which can happen fairly frequently when you’re
dealing with a material like limestone,” McGinnis
said. “An alarm comes up on the screen and we can
send a repairman immediately so that there is
minimal disruption of production flow.

“We use the same on-screen I/O data to calcu-
late our daily production rates as well,” he added.
“We track accumulated ram strokes, and therefore
accumulated tons, per day and we can tell how we’re
doing relative to the targets set for that day. This is
stored for historical trending as well.”

The new data acquisition and monitoring
capabilities are especially valuable for managing the
kiln operation. Although no closed loop control is
used, the system monitors motor speed and kiln
rotation rate as well as temperatures at multiple
points through the 218-foot long, 10-foot diameter
cylinder. The kiln rotates at only 105 revolutions
per hour (RPH), so it takes up to four hours for
limestone to go from one end to the other and be
burned into calcined lime. The coal and gas used to
fire the kiln must also be conveyed in a timely
fashion to insure that consistent temperatures can be
maintained 24 hours a day. It’s critical for the new
system to track what control actions operators have
taken because the results of their selection
may not show up until well into the next
shift.

“That’s an important feature of this system
because any time an operator makes a task selection
on his screen, the same data is displayed on the other
two control screens so that all operators will be
working from the same information,” McGinnis
noted. “This is something that was difficult to
control previously and it’s especially critical when
you have equipment that cycles this slowly.”

“We have a global alarm indication on every
screen page so that no matter what an operator is
doing at the time an alarm occurs, he can go directly
to that screen and respond accordingly,” he said. “In
some cases, help information pops up on-screen to
assist the operator. In addition, we now have a full-
page alarm summary that records all activity so
management can spot trends that need correction.”

**Bottom Line Results**

The original goal for the control automation
project was to increase production capability with-
out increasing staff size, and that’s been accom-
plished in dramatic fashion. Ohio Lime still has
only eight crew members in the operations depart-
ment, yet productivity has improved by 25 per cent
— far more than the 10 per cent improvement
targeted by management.