Distributed Control Architecture Offers Medusa Cement Improved Data Handling & Operating Efficiencies

Application Solution

Medusa Corporation, Wampum, Pennsylvania facility.

Medusa Corporation, Charlevoix, Michigan facility.

Application Requirements

The Medusa Corporation, a leading U.S. cement-producer, recently modernized plants in Wampum, Pennsylvania and Charlevoix, Michigan. Both plants previously used a highly centralized control architecture involving various black box devices such as strip chart recorders, single loop controllers and pneumatic controls.

Allen-Bradley Solution

The modernized plants now feature a modern, highly distributed control architecture using Allen-Bradley PLC-5® programmable controllers, local and remote I/O modules, Variable Speed AC and DC Drives as well as programming and other software products from a Allen-Bradley's affilate, Rockwell Software Inc. The modernization effort at both facilities was led by FLS Automation, a leading system integrator for the cement industry.

Results Achieved

- Significantly improved data handling.
- Significantly improved operating efficiencies.
- Reduction of fuel consumption in BTU/TON.
- Reduction in power needs for cement production.
- Increase in clinker capacity (Wampum)
- Improvements in maintenance/ configuration (Both):
  - Readily available data
  - Better graphical user-interfaces
  - Ability to alter system configuration at any time
- Improved data trending and recording capabilities

Challenges

Both plants sought improved data handling capabilities. First, the new system needed to allow maintenance

The need to resume operations quickly at Charlevoix meant that 1771 Remote I/O was installed in existing cabinetry, and connected to existing field wiring.

(configuration) without requiring special skills by plant personnel. Beyond this, the system had to allow on-line programming changes to the control system, and to any or all graphical user-interfaces as well as changes in the system's configuration at any time.

Plant management wanted the ability to communicate between personal computers and programmable controller systems. This enables the programming of a supervisory control system, generation of reports, data logging and connection to the plant's FLS Automation ECS (Expert Control and Supervision). At Wampum it is also planned, for reporting purposes, that the system will become capable of communicating to higher level computers outside plant operations.

The Solution

Under the modernization effort, both plants went to a distributed control architecture using Allen-Bradley PLC-5® programmable controllers, with local and remote I/O modules gathering I/O points from Variable Speed AC and DC Drives. The PLC-5 controllers are programmed with software from Rockwell Software Inc. Supervisory control software from FLS oversees local and remote I/O and programmable controllers, and provides operator interface and reporting capabilities.

Application Overview

The Wampum plant produces 2,250 tons of clinker and 3,000 tons of cement a day in the form of types I, IA, II, III, V and masonry cements, with the end product either shipped in packages (12%) or commercial truck and rail carriers (88%). The plant uses waste-derived liquid fuel as a supplement to coal. With a 1.4 million ton annual capacity, the Charlevoix plant serves 8 Medusa owned terminals in North America's Great Lakes region by means of lake freighters owned by Medusa. Unlike the Wampum plant, Charlevoix's single kiln is solely coal fired. Like the Wampum plant, Charlevoix produces Type I, IA, type III and masonry cements.
At Wampum, an Ethernet network serves as a backbone on which all of the plant's PLC-5 controllers reside and communicate to the plant's FLS Automation system, located in the control room. An Allen-Bradley PLC-5/80E programmable controller is the plant's largest and controls the 1,940 I/O points associated with the plant's three 12 by 390 feet rotary kilns. PLC-5/40E programmable controllers having built-in Ethernet networking connections process I/O points at the plant's raw mills, finish mills, and tank farm.

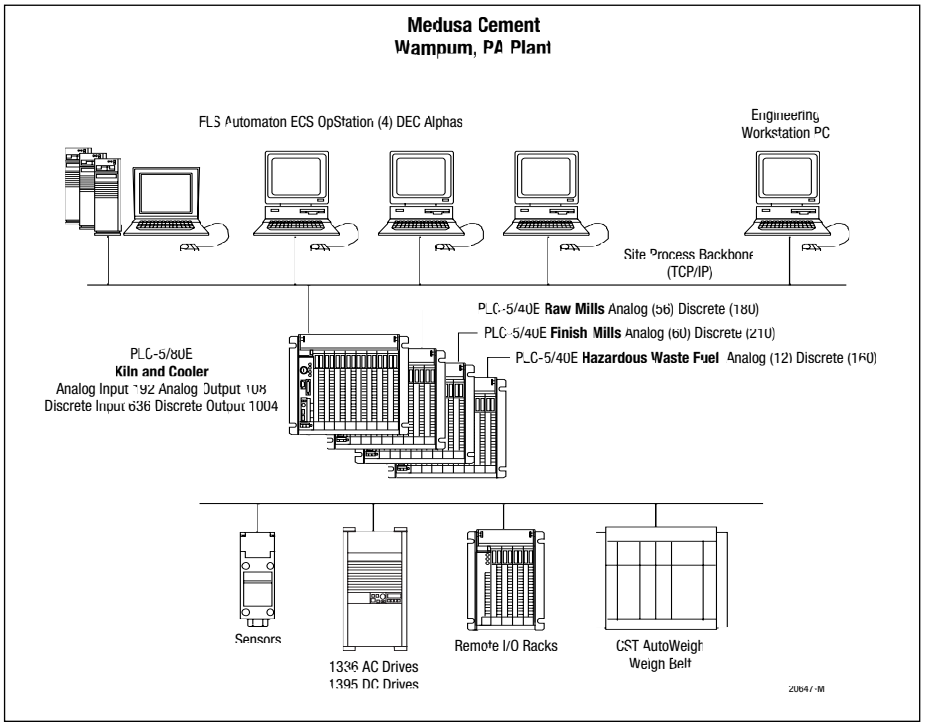
Beneath the Ethernet backbone at Wampum, Allen-Bradley's Remote I/O network allows remote I/O racks to gather I/O from the plant's three kilns, cooler, gravel bed filter, precipitator room, silos, and waste fuel area. I/O is also used in controlling and/or monitoring the performance of eight Allen-Bradley 1336 AC

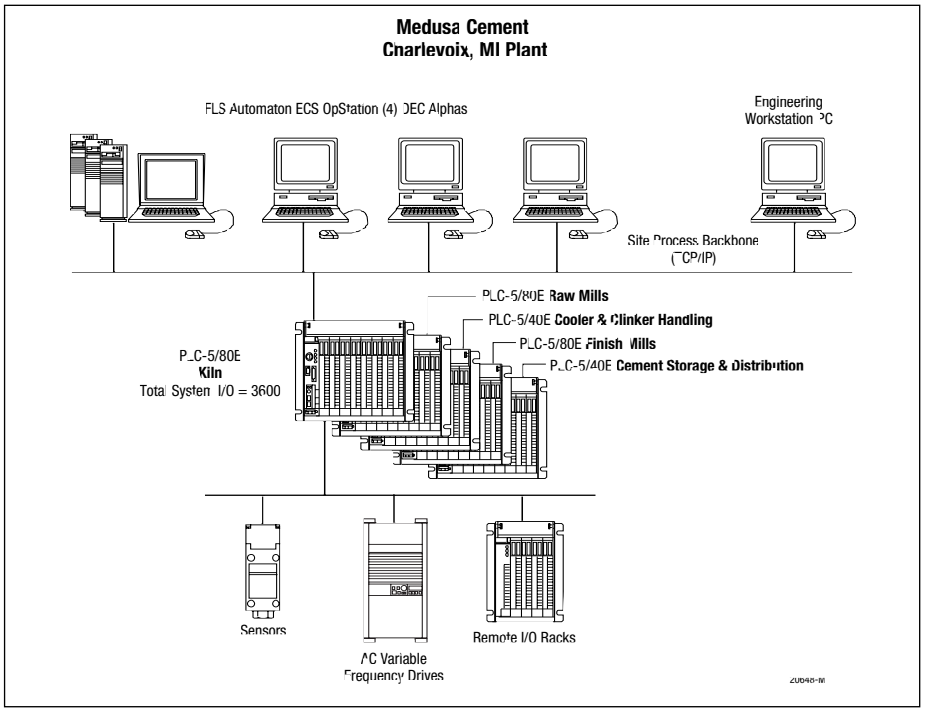
Variable Frequency Drives for the cooler fans and five 1395 DC Drives on the kilns and coolers as well as the CST AutoWeigh belt scales in the raw material and kiln feeders. A Digital Equipment Corporation VAX Alpha workstation is used to monitor and/or make alterations to programmable controller programs. The Ethernet connection will, in the near future, allow an easy link with the plant's MIS operations for Oracle-based database production reports and cost accounting. Allen-Bradley's INTERCHANGE™ software provides an Application Programming Interface between PLC-5 controllers and other computing devices over Ethernet networks using standard TCP/IP services.

Charlevoix similarly employs an Ethernet network to link PLC controllers with the FLS Automation system and DEC VAX Alpha Workstation. (A Data Highway network provides a secondary link to the same nodes, as a result of the more recent startup activities there.) The plant employs five programmable controllers altogether, with three PLC-5/80E and two PLC-5/40E programmable controllers for the cooler, finish mill, raw grind, kiln and cement storage areas.

At Charlevoix, roughly 3,600 I/O points are gathered via local and remote chassis. Start-up was quickly accomplished as remote I/O racks were installed in the very same cabinets that housed the previous control system, thereby allowing existing plant field wiring to be reused. I/O is also used in controlling and/or monitoring the performance of variable frequency drives as well as an on-line X-ray system that adjusts the raw mix feeders based on a compositional analysis.

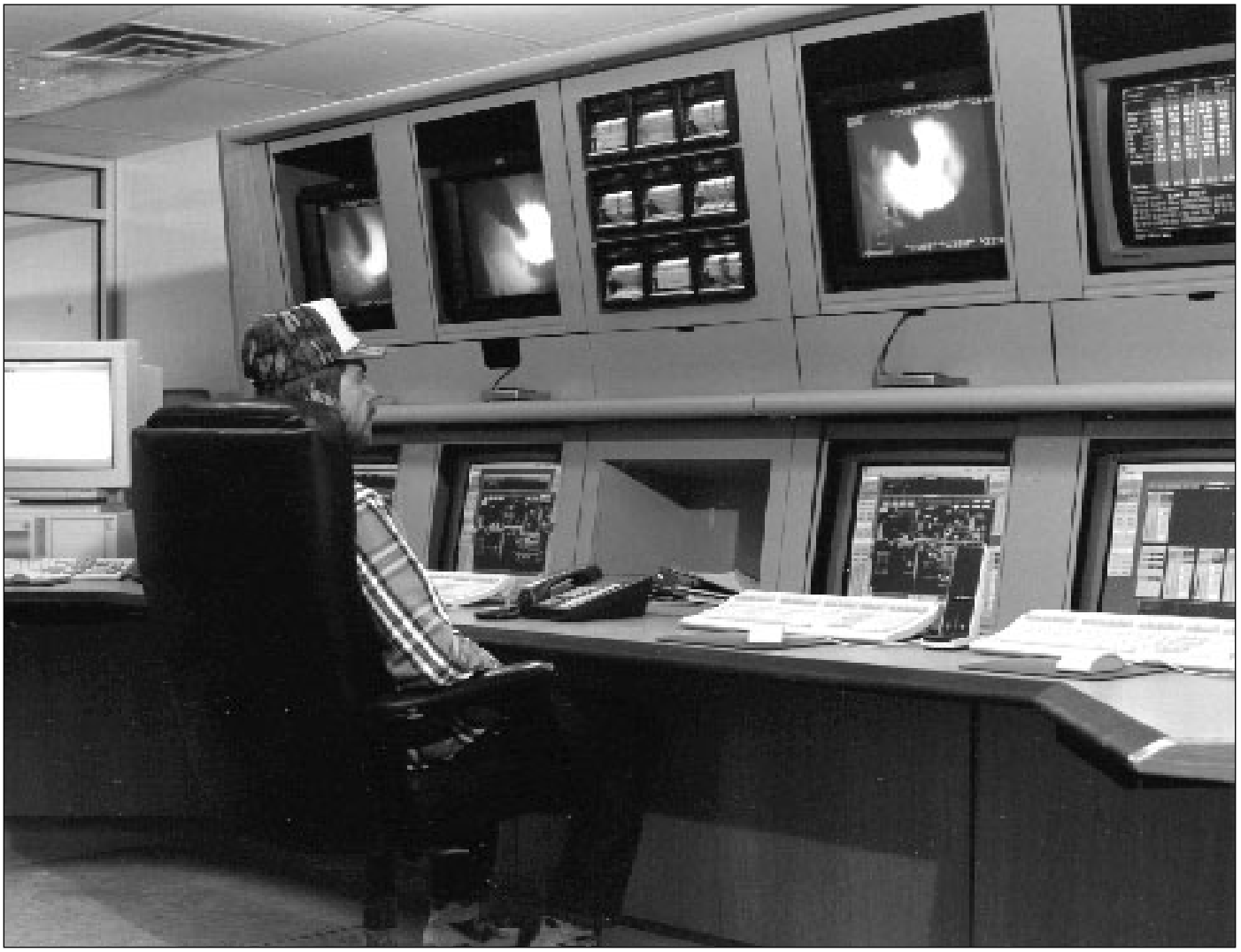
Control Architecture





Results Achieved

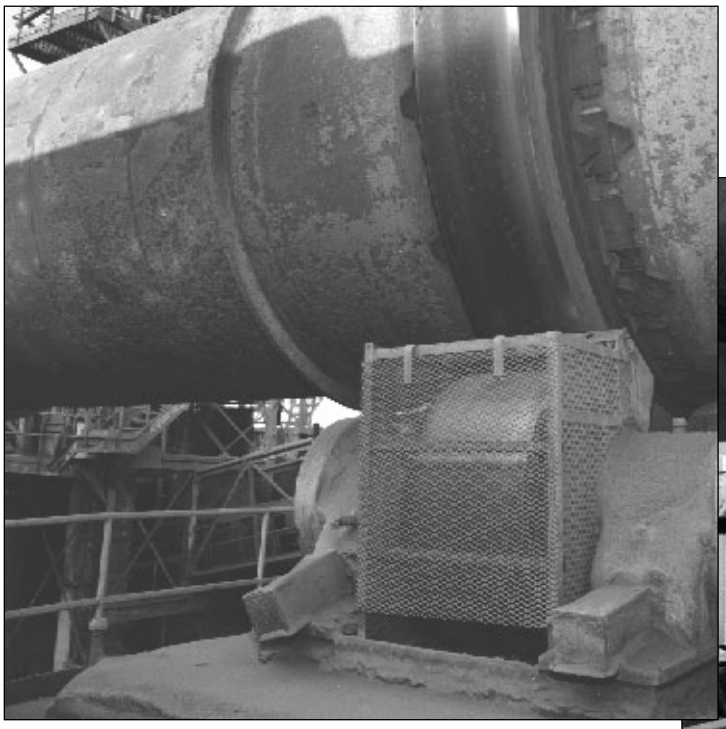
The new control architecture has improved the Wampum plant's operating efficiencies by controlling the process better and eliminating the effect of the shift operator changes. Maintaining a certain kiln exit NOx level enables burning

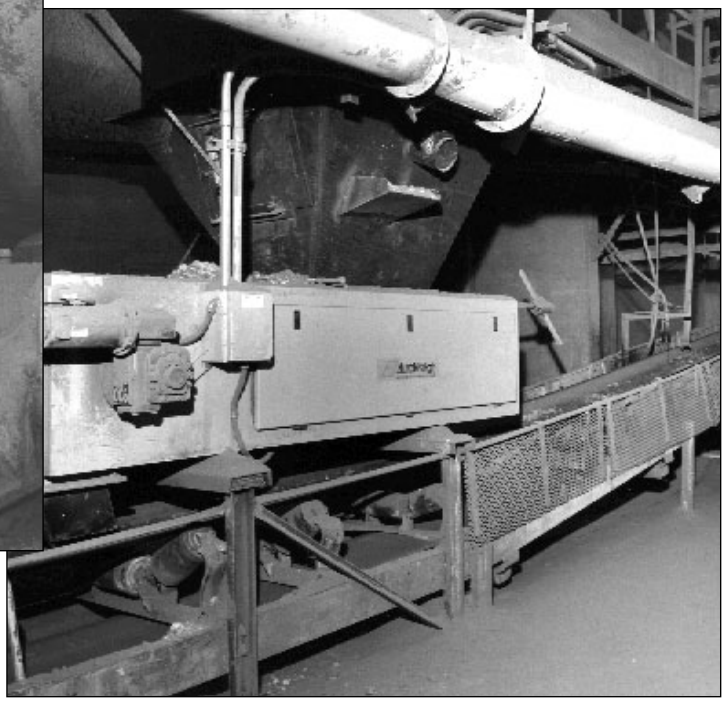


The Control Room at Medusa's Wampum Facility.

and recording capabilities. Before only strip charts existed, and measurements were suspect, difficult to look up, and mechanical problems could interfere with data gathering. Now all variables are trended, for months at a time, so cause and effect relationships can be seen. This is critical for a process where correlations can exist between variables at different points in the process. Alarm lists that can be more readily understood now help operators to identify potential problems quickly where before there were only alarm lights and annunciators.

Thus, in both plants a range of benefits exists as a result of a new control architecture that offers a platform for continuous process improvements.





Remote I/O points at Wampum gathered from drives controlling motors, as well as from this CST AutoWeigh Belt.

zone temperature to be at the lowest possible level without affecting cement clinker quality. By achieving an overall reduction in burning zone temperature of 200-300 degrees (F), primary fuel consumption has been reduced 7-10%.

The elimination of overburning during the clinkering process at Wampum has increased the amount of finish grinding of clinker into cement. Overburning typically increases KWH/TON consumed during finish grinding. Its near elimination at the Wampum plant has resulted in a 5% increase in finish grinding of clinker into cement, while finishing mill energy requirements have decreased nearly 10%.

The new system at Wampum has also resulted in an increase in the life and uptime of the refractory. By contributing to more stable kiln operation, kiln uptime has increased 1.5%. There are fewer kiln pushes, and consequently, a lessening of damage to the cooler and associated equipment typically caused when underburnt material leaves the cooler too quickly. A prolonged life for the burning zone refractory has yielded an estimated 8.5% reduction in annual refractory cost. By lowering kiln temperatures, more time can elapse before the kiln lining must be replaced.

Wampum's waste fuel area has an independent system operating in conjunction with a programmable controller based system that provides it and the plant-wide control system with data. The waste tank farm area consists of six 20,000 gallon storage tanks. Material from these are blended into two 60,000 gallon burn tanks, one of which is consumed each day. A programmable controller with analog input and output modules is used to gather data from pressure transmitters on the tanks which are used to determine the tank levels. A WinView software package from Rockwell Software Inc. depicts the tanks and measurements on a PC inside the Waste Fuels Area control room.

At Charlevoix in particular, a key justification can be found in the improvements made in data trending

Rockwell Automation

Allen-Bradley

Allen-Bradley, a Rockwell Automation business, has been helping its customers improve productivity and quality for more than 90 years. We design, manufacture and support a broad range of automation products worldwide. They include logic processors, power and motion control devices, operator interfaces, sensors and a variety of software. Rockwell is one of the world's leading technology companies.

Worldwide Representation.

Argentina • Australia • Austria • Bahrain • Belgium • Brazil • Bulgaria • Canada • Chile • China, PRC • Colombia • Costa Rica • Croatia • Cyprus • Czech Republic • Denmark • Ecuador • Egypt • El Salvador • Finland • France • Germany • Greece • Guatemala • Honduras • Hong Kong • Hungary • Iceland • India • Indonesia • Ireland • Israel • Italy • Jamaica • Japan • Jordan • Korea • Kuwait • Lebanon • Malaysia • Mexico • The Netherlands • New Zealand • Norway • Pakistan • Peru • Philippines • Poland • Portugal • Puerto Rico • Qatar • Romania • Russia–CIS • Saudi Arabia • Singapore • Slovakia • Slovenia • South Africa, Republic • Spain • Sweden • Switzerland • Taiwan • Thailand • Turkey • United Arab Emirates • United Kingdom • United States • Uruguay • Venezuela • Yugoslavia

Allen-Bradley Headquarters, 1201 South Second Street, Milwaukee, WI 53204 USA, Tel (1) 414 382-2000 Fax (1) 414 382-4444

Publication 1785-1.31 – March 1996