Phased modernization helps National Starch reduce cycle time by 50% with Siemens PCS 7 DCS

Following a multi-phase upgrade of an existing facility, National Starch and Chemical Company worked with Siemens to improve product quality and lower cycle time by 50 percent at a new plant in Salisbury, N.C.

The installation included Siemens PCS 7 distributed control system that automates the production of moisture resistant and crack resistant adhesive resins found in microchips used in cell phones, laptops, PDAs, and other electronic equipment worldwide.

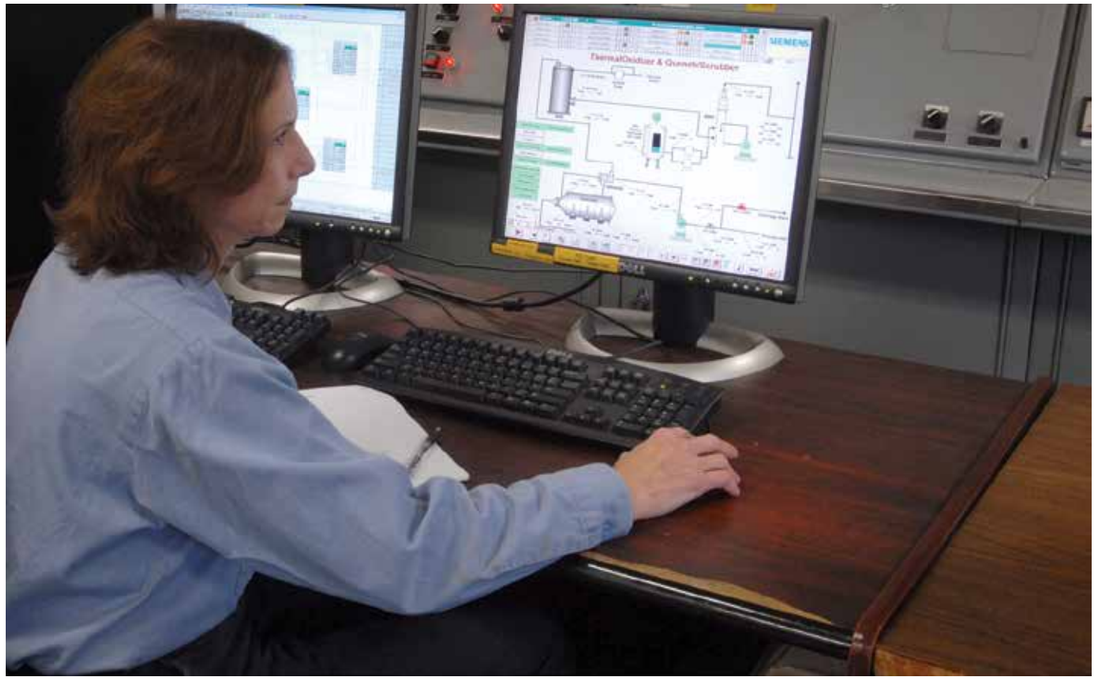
The next time you drop your cell phone, and it still works, you can thank companies like National Starch and Chemical Company. Nearly every cell phone manufactured today contains semiconductor chips fabricated with flexible, moisture resistant, and crack resistant adhesive resins supplied by the company's Electronic Materials Division.

The specialty resins are also enhancing the reliability of chips found in laptops, PDAs, and other electronic equipment worldwide.

Jeff Mueller is engineering manager at the National Starch plant and R&D facility in Salisbury, NC, where many of the specialty resins are produced.

"Reliability is our highest priority at National Starch. Our customers depend on it," said Mueller. "Unplanned shutdowns can easily add up to millions in losses very quickly and result in our customers finding another supplier."

Mueller says in addition to reliability, other National Starch manufacturing priorities include reducing time to market and using up-to-date technology to stay competitive. He adds that reproducibility is also critical: "A chip manufacturer invests an enormous amount of money in its manufacturing process and expects us to supply a product that precisely dispenses out of a syringe. That is why product consistency is a priority."



Technology roadmap

In 2002, Mueller developed a staged Manufacturing Control Technology Roadmap to address the company's manufacturing imperatives. The roadmap would serve as a guide to help the company improve product reproducibility, extend the lifecycle of the installed hardware base at its chemicals manufacturing plant, and plan for a new, nearby manufacturing facility.

National Starch determined that partnering with an automation and controls supplier was critical to the success of the roadmap. In order to choose the right automation and controls partner, National Starch, Control Corporation of America (CCA), and WESCO Process Automation created an Evaluation Matrix that listed and ranked nine criteria for selection: Cost, Overall Capability, Operator Friendliness, Programmer Friendliness, Open Communications Standard, TI 505 legacy control platform Hardware Utilization, TI 505 Program Conversion/Reuse, Installed Base/Presence within ICI (National Starch's parent company), and Batch Recipe capabilities.

Three well-known process automation vendors were invited to make presentations to an evaluation committee who would compare the companies' visions to the National Starch Prioritization Matrix criteria.

"When one vendor presented its recommendations the vision wasn't there," Mueller says. "I heard the word 'soon' a lot. For example, they said they would soon have a package that would allow us to convert to batch recipes. When I heard that I got nervous."

"When we want to make data driven decisions, we set up a prioritization matrix," Mueller said. "We go to the people who will use the system and ask them to rank the criteria in order of importance. As the vendors gave their presentations, we filled in the matrix. Siemens SIMATIC®
PCS 7 distributed control system (DCS) gave us the best system."

Staged approach minimizes downtime

To minimize interruptions to the existing operations, and establish a clear path for other improvements, National Starch implemented a staged migration to Siemens PCS 7 DCS.

The existing control system operated with different versions of software and hardware. To implement a new control system, it was necessary to bring the existing system to a common stage and then proceed with the migration. This strategy minimized the risk of disrupting the production and allowed National Starch to follow a consistent migration plan across all reactors.

The first stage of the roadmap was implemented in 2003. Mueller said the company decided to standardize and convert two 435 PLCs which controlled a wiped film evaporator and comber pan dryer to Siemens SIMATIC 545 and 505 controllers from Siemens.

"The migration to the 545 controllers allowed us to standardize our PLCs, and then evaluate the options going forward. The goal was to utilize existing installed hardware in the new system."

The second stage took place in 2004 and focused on adding a new reactor train at the existing organic chemicals plant. Mueller says the goal was to gain experience working with the PCS 7 DCS and the PROFIBUS communications network to connect with measurement and control devices.

"We minimized the risk of disrupting production by starting on a low-risk project," Mueller says. "This strategy allowed us to implement programming blocks to use as a template for future systems and as a stepping stone to batch recipe management."

The installation of the new reactor train included installing the PCS 7 DCS with a redundant SIMATIC S7-417H controller. The installation also included Siemens
PCS 7 Operator Stations (OS) connected via Ethernet throughout the organic chemicals plant floor.

"The operators have become familiar with the PCS 7 HMI's look and feel, as well as its functionality," Mueller said. "The system was designed to have a similar look to our existing HMI platform so there is very little difference to the operators. At the same time, it provides more capabilities, which enables the operators to see if something is interlocked or recall historical and trending data instantaneously. They are pretty happy with that."

In 2005, the PCS 7 system had proven itself on the new reactor train, and Mueller executed stage three of the roadmap, migrating from Siemens SIMATIC 545 and 505 controllers to Siemens PCS 7 DCS. The migration was successfully completed on one of the existing reactor trains and a pan dryer in 2005.

By migrating the automation hardware and software to PCS 7 one reactor at a time, Mueller was able to ensure that production was not interrupted. He was also able to develop standard function blocks and control modules that could support batch recipe capabilities and serve as templates for future systems. The remaining reactor trains will be upgraded to the Siemens
PCS 7 DCS over the next two years.

Fieldbus benefits

At the Salisbury, NC, manufacturing plant, National Starch wanted to maximize its return on assets by retaining all of its field instrumentation and TI 545 I/O modules as part of the migration to PCS 7. Replacing all of the hardware and control systems would have been very expensive.

However, Mueller said because of the openness of PROFIBUS PA, he was able to retain the instrumentation standards from his long-established instrumentation vendors, including E&H, Rosemount, Mettler-Toledo, and OhmartVega.

Additionally, because National Starch standardized on PROFIBUS to connect its SIMATIC 505 and SIMATIC S7 S-417H controllers, a great deal of money was saved on traditional wiring.

"We saved an enormous amount of money," Mueller said. "Think about all those wires, all the input and output back to the cards. To be able to link in that hardware with a single cable gave us incredible savings."

National Starch is also taking advantage of new, advanced diagnostics enabled by the PROFIBUS communications network and the PCS 7 platform, including the ability to track instrumentation changes.

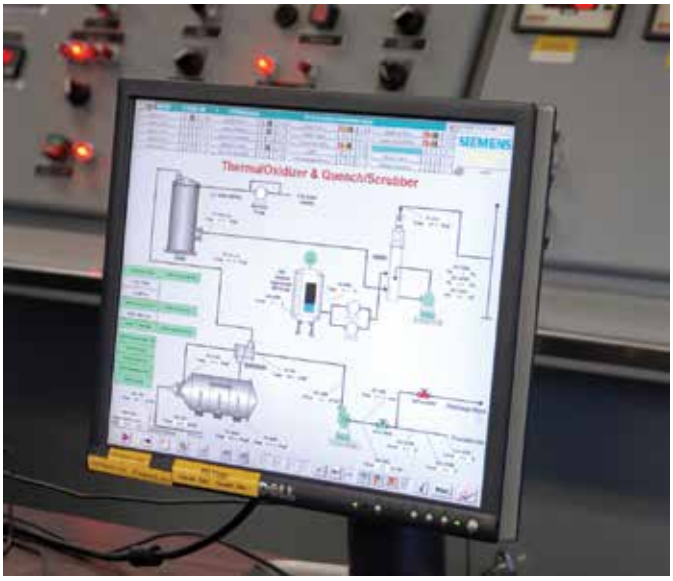
Since the existing plant was a Class I, Div 2 environment, intrinsic safety precautions were also considered. Mueller said he had several options for complying with regulations. He could enclose the wiring in explosion-proof conduit which would be too laborious and expensive, he could have protective isolation barriers installed, or he could install hardware constructed with built-in intrinsic safety.

"Siemens has hardware with built-in intrinsic safety capability that uses extremely low current," Mueller explained. "The connectivity of PROFIBUS PA and ET200 iS I/O modules are designed specifically for intrinsically-safe areas and applications in electrically-hazardous locations. That is an advantage to us. When we troubleshoot, we don't have to worry if we've popped an isolation barrier and have to go and check for a bad fuse. As a result, we save a substantial amount of time and money."

Expansion and addition

With the completion of all three implementation stages at the existing chemicals manufacturing plant, Mueller revisited the objectives of the roadmap – to improve product reproducibility, lower manufacturing costs, and proceed with construction of a new plant that will produce specialty chemicals using automated batch processes.

Construction on the new EManate organics plant facility, located 150 feet away from the existing chemicals plant, began in 2005 and was completed in 2006.



The cornerstone of the new construction is Siemens Totally Integrated Automation system that includes the PCS 7 DCS comprised of batch recipe software, and PROFIBUS communication networks.

The S7-417H processor in the control room is connected by fiber optic cable to an identical controller in the existing plant control room. This gives manufacturing the capability to switch control of each facility from one location to another in the case of a power loss or surge.

The new construction also includes the full line of Siemens electrical system components, including switchgear, motor control centers, variable frequency drives, breaker panels, wire and cable, instruments, and control valves.

Results

The EManate facility was brought on line in 2006 and plans are underway to activate another reactor train early in 2007. Mueller said the first EManate qualification batches hit the predicted cycle time marks – a vast improvement from previous operations.

> "We are looking at improving our production time by 50 percent when compared to the existing plant," Mueller said. "Also, we are anticipating significant improvements in product quality, including a reduction in the variability of product viscosity due to the batch recipe system. It is nice to go to one supplier for the entire automation line and know that it is all going to work together."

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