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***Dennis Boyd
Melting Area Electrical
Systems Supervisor***

Global Steel Industry Leader Revolutionizes Production with Wonderware

Since ancient metal workers first created it by removing nearly all of the impurities from iron at least 3,000 years ago, steel has had a profound impact on civilization. From the hand-forged weapons that gave tribal leaders a dominant advantage over their bronze-equipped neighbors to the mass-produced railway lines and trains that drove the industrial revolution that forged the world we live in today, the common, critical ingredient has been steel.

Though the importance of this iron/carbon alloy hasn't changed, the way we produce it has been revolutionized. One of the world's leading steel producers, Nucor Steel employs the latest technological advances - including electric arc furnaces run by production and performance management solutions from Wonderware, a business unit of Invensys - to maintain its position at the forefront of the industry.



Wonderware is the leading provider of industrial automation and information software. Wonderware's software solutions empower users to improve operational efficiencies, product quality and plant throughput by leveraging the plant's existing hardware, software and applications and deliver a rapid return on investment with the lowest possible system life-cycle costs.

"We live in a worldwide economy now," said Dennis Boyd, of Nucor. "So it's important that we stay on the leading edge of technology, both in how we control our furnaces and in how we collect data from them." As supervisor of the melting area electrical systems at Nucor's mill in Berkeley, South Carolina, Boyd helped revamp the mill's control systems with Wonderware industrial control platforms. With competitive pressures growing in the global steel market, Boyd and his colleagues wanted to make sure they were getting as much capacity as possible from their operation and solidifying the company's market position.

Flexibility Is Critical

The melting area of a steel mill is one of the harshest industrial environments in the manufacturing world. As temperatures soar to 3000 degrees Fahrenheit - almost one-third of the surface temperature of the Sun - and raw materials measured in the hundreds of tons are manipulated, an incredible strain is placed on equipment and control systems.



Tons of Rolled Sheet Steel at Nucor Steel Berkeley

The majority of the world's carbon and alloy steel production uses electric arc furnaces, which are fired primarily with scrap steel. At Nucor's Berkeley mill each load consists of 180 tons of metal, about 80 percent of which is recycled scrap. Once charged into the furnace, an intensely enormous amount of energy - 1,200 volts and 160,000 amps - is added, generating enough heat to melt the charge. Impurities float to the top and are removed, leaving 165 to 170 tons of pure liquid metal. Carbon and alloys are then added to the mix to add tensile quality and produce the required grade of steel. Once it's determined to be perfect it's transferred to the casters where it's molded into sheets of differing thicknesses and widths to meet specific customer orders.

Flexibility in this environment is a key challenge as equipment disruptions occur frequently and components must be replaced. The organization must also be prepared to respond to rapidly changing market conditions. By providing a clear picture of what's happening within the process, Wonderware delivers this flexibility.

"One of the issues we deal with a lot is the rapid changes we need to make," said Mike Higgins, Level 2 Automation Engineer, Nucor Steel Berkeley. Throughout the implementation of the new system Higgins was responsible for programming PLC's and managing the supervisory control system. "Our mill is dynamic, our company is dynamic and our shop is dynamic. We are always trying to make changes to improve our process and we needed a system that would allow us to do that as quickly as possible. The less time we spend doing programming allows us to spend more time doing improvements and raising our total profits for the company."

According to Higgins, the Berkeley mill has relied on Wonderware's industry-leading InTouch supervisory control and visualization software, since it opened in 1997. But by 2002, the mill had outgrown the trending and analysis capabilities of the existing InTouch application and needed to take its data collection and analysis efforts to the next level. With the need for an advanced trending tool to help identify and eliminate problems that caused downtime becoming acute, Nucor managers turned to InSource Solutions - Wonderware's regional Value Added Reseller - and asked for a better way to collect and trend data. The only caveats: the new system had to work with the Wonderware applications the mill already had in place, and it had to deliver a thin client that could withstand the extreme nature of the production floor.

InSource suggested updating and building on the InTouch application already in place with Wonderware's IndustrialSQL Server historian and Industrial Application Server.

The IndustrialSQL Server real-time plant historian puts the intelligence in Wonderware's plant intelligence solutions, delivering the data - both current and historical - that empowered the melt shop team to do the detailed analysis and trending and has enabled them to identify and eliminate the problems that cause downtime.

Thanks to Invensys' unique ArchestrA software architecture on which the Industrial Application Server is built, Nucor was able to centralize all the data coming out of the different furnaces in the melt shop, providing tight integration regardless of its source. The ArchestrA architecture is built on the latest Microsoft .NET and Windows Server technologies and industrializes these platforms to offer a unified environment that enables the lowest integration and life-cycle costs.

The Industrial Application Server provides a unified environment for visualization, plant history, device communications and automation application integration. Additionally, it provides a common control and analysis capability and a facility for making rapid changes to improve production processes.

Of particular value to Nucor Steel Berkeley, ArchestrA technology allows the use of standardized Application Objects for faster engineering. This means that new equipment can be added or removed from the mix easier than ever before. In an environment like the melting area of a steel mill, where equipment has a short life-cycle, this is of critical importance.

"Before we got up and running with Industrial Application Server and the IndustrialSQL Server historian, it would take days to add a new piece of equipment to the control system," said Higgins. "Now I can do that in a matter of minutes."

Profound And Immediate Benefits

"One of the biggest benefits we saw was the elimination of downtime," said Boyd. A common problem experienced in the melting area involved errors in the melt process that resulted in holes being burned in the sidewalls of the furnaces or the roof over them. These holes can be caused by a number of different failures, including an arc deflection, an arc flare or blowback from a co-jet - which blasts pure oxygen into the reaction to increase the temperature. Each of these errors causes the energy that should be passing through the scrap steel charge to be directed at the sidewall, blasting a fissure that will take hours - and possibly even days - to repair.

"We use sensors to track the temperatures on the side of the furnace," added Boyd. "We were able to collect and track this much more accurately and come up with more sophisticated control processes." Specifically, he said, this enabled Nucor to do two things: "Right off it allowed us to alarm and shut down before we got holes. We've all but eliminated the occurrence of these holes since we got enough data from the system to analyze and identify trends from and that has saved 2-5% productivity just through elimination of downtime. It also allowed us to go to more advanced controls where rather than shutting the furnace off, we can just volt the furnace down. That gave us a 5-10% gain in average voltage, which is directly proportional to productivity."

Reduced downtime and increased productivity was only the start of the benefits experienced by Nucor Berkeley following the implementation. The new system has also had a dramatic impact on the quality of daily executive reporting. Prior to deploying the new system, operations data was fed directly from the PLC's on the shop floor into the centralized plant-wide data control system where a custom 'C' application would retranslate it into the database. This meant that three disparate sets of the data were required, and they weren't always consistent.

Thanks to the open .NET architecture of the Wonderware Industrial Application Server, Mike Higgins and his team were able to completely bypass the old system and feed data directly from the InTouch control system into the IndustrialSQL Server historian and then into the plant-wide data collection system.

Metrics from the day-to-day operation, such as the number of tons charged into each load, the temperature in the furnace and the amount of time the furnaces take to operate are collected and analyzed each day to identify opportunities to improve processes - and with the Industrial Application Server, managers are confident that the information they are working from is accurate.

Higgins said, "The IndustrialSQL Server historian is something we've been looking for. We'd gotten to the point where we knew we needed to make improvements to our data collection and analysis. We would visit other mills and we were way behind what other people were doing and now we are light years ahead. We went from being the butt of the spear to being the tip of the spear.

"Almost immediately after introducing the IndustrialSQL Server historian, we were able to see rapid, immediate feedback on our data and processes. We started by collecting failure data but over time we have been able to use that as a basis, trending those failures so now we can predict when they will occur and schedule preventive maintenance to minimize downtime. We are also able to track what happens at each step in the production process, sampling the steel at different stages to make sure each batch is going to meet the grade and quality demands of our customers."

Each year the Nucor Steel mill in Berkeley, South Carolina, produces more than 2,500,000 tons of rolled sheet steel and 1,000,000 tons of steel beams and girders in twenty different grades, depending upon the customer's requirements. The steel is then shipped to customers who either reprocess it and resell it or turn it into finished goods, such as refrigerators and automotive parts. Thanks to Wonderware, Nucor Steel Berkeley is doing this more efficiently and profitably than ever before.

"The steel industry is a very harsh environment," said Boyd. "Everything is temporary. Nothing is permanent. We see equipment destroyed and replaced on a daily basis. And we needed a system that would enable us to make those changes without reinventing the wheel on a daily basis. Wonderware delivered that system and I would recommend it to anybody who is looking for a way to improve their process, speed up programming changes and increase profits."



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