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Success Story

Metal Products

InTouch, IndustrialSQL Server, ActiveFactory

Showa Denko Carbon Deploys Wonderware FactorySuite Modules to Streamline Production & Track Genealogy of Graphite Electrodes

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Environmental Technician

Ridgeville, S.C. — The Showa Denko Carbon plant is one of the world's leading producers of graphite electrodes used to fire electric arc furnaces for making carbon and alloy steels. Hidden among the Carolina pines and palm trees just up the highway from the stately mansions of oceanfront Charleston, the Showa Denko plant is a well-kept business secret, despite its importance to the steel industry.

Today, the majority of the world's steel production uses electric arc furnaces, which are fired with nearly-100% scrap steel. These steel-melting furnaces pass electricity between electrodes and through the scrap steel. The arcing that results generates sufficient heat to very rapidly melt the scrap steel charge. A key element to the efficiency and environmental friendliness of the process is the ultra-high power (UHP) graphite electrodes used to create the arcing.

High quality and consistency of product are critical in the making of electrodes. Since the plant opened in 1998, statistical process control (SPC) and process integration have been important at Showa Denko. Although the batch production process was fully automated, engineering staff and operators didn't have good visability into the process and thus could not optimize its complex steps. This all changed in 2001, when Showa Denko upgraded to Wonderware® FactorySuite® software and its engineering staff designed open-architecture solutions to monitor and control every step of production and track every part – from incoming bulk raw materials to the finished electrodes that are shipped to customers around the world. The system incorporates InTouch® human-machine interface (HMI) software, the IndustrialSQL Server™ real-time plant historian and ActiveFactory™ data trending and reporting software .

Complex Batch Production

The batch production of graphite electrodes is a complex process that takes more than one month to complete. The process requires precise milling and blending of needle coke, coal tar pitch and selected additives to create a mixture that is then extruded into the electrode form. Each rod is baked to about 800°C to convert it into hard, amorphous carbon, which is then impregnated with petroleum pitch to increase its density and strength as well as its end-product electrical conductivity. Rods are then baked again to transform the added pitch into carbon. Finally, the rods are heated to 3,000°C in electrically powered furnaces, called graphetizers. This intense heat changes the crystalline structure of the material to the graphite form, which enhances the machining, electrical, thermal and mechanical properties of the rods.

The graphetized rods are then machined to the required diameter – from 18 to 30 inches, depending on the electrode ordered by the customer – in numerically controlled lathes. Tapered sockets are machined into both ends of each electrode and a graphite connecting pin is pre-set into one end so that customers can screw the rods together, making a continuous electrode that can be fed into the arc furnace as the rods are consumed in the steel production process.

The finished rods measure up to 115 inches in length and weigh up to 5,000 pounds. Each rod offers particular characteristics important for optimum electric arc furnace use, including superior electrical conductivity, high resistance to thermal shock damage and low oxidation rates at elevated temperatures. Nothing goes to waste during the process. The scrap graphite that's machined from each rod is collected, screened and milled for bulk granular shipment to automotive parts manufacturers for making disc brake pads and drum brake shoes.

Managing the process involves tight statistical process control of every batch step; extensive data collection and tracking of all parameters on every electrode produced; and trending and reporting on operations, both for real-time process validation and for environmental compliance. Production is controlled using programmable logic controllers (PLCs), with the InTouch HMI serving as the operator interface through which plant staff launch tasks and monitor production processes. Showa Denko uses the IndustrialSQL Server historian as the database repository for its high-speed data collection system, which is used in conjunction with the plant's DARTS® system (Data Acquisition & Rod Tracking System).

The process of tracking and compiling a history on individual electrodes begins in the forming stage and ends when the finished electrode is shipped to the customer. An electrode history is maintained on every piece produced and all collected data is amassed in the IndustrialSQL Server historian to provide access to Showa Denko staff for many different technical and management applications. These include production reporting, inventory control, process analysis and product-quality monitoring.

The continuous data stream compiled by DARTS is the heart of Showa Denko's production-quality monitoring and control system. Whereas DARTS and the IndustrialSQL Server historian make up the information and identification system, SPC provides tight real-time control of the batch manufacturing operations. InTouch screens give operators feedback on whether essential operations are being performed within specifications. They can respond instantly to out-of-spec alarms and take corrective action to resolve any variance.

Unique Tracking System

"The initial scope of the DARTS project was to enhance the 'visability' of our historical data," explained Mark Little, Showa Denko instrumentation and systems engineer. "We were looking for enhanced features like the ability to have multi-axis graphs that could display several tags per axis, the ability to export directly to Microsoft® Excel, and a user-friendly, click-and-drag, zoom-and-drill-down feature.

"But, over time, this project has turned into a system that is able to graph any ODBC data set," Little said. "It provides a rich set of user features that give us the ability to visualize the data in virtually any way we desire. It also provides a scripting language that allows us to customize graphs on every refresh, based on the script written. The program also serves as a compiled dynamic link library that enables our users to view graphs over the plant intranet. Or, it functions as a client-side executable that can run on a desktop through a LAN. One of our latest additions is the ability to retrieve data over Web services, using SOAP and XML technology."

The end result is that Showa Denko staff can deploy and use the data collected in the IndustrialSQL Server historian as efficiently and effectively as possible, all the way from the shop floor, through the process engineering department and up to the management staff. The IndustrialSQL Server historian has allowed staff to create a plant-wide data deployment system that uses whatever implementation is most effective for individual users – from thin client to thick client, aggregate and direct queries and more. The end result has been enhanced efficiency of production operations, reduced scrap volume, better management of electrical power usage and automated data reporting to government environmental agencies. In some cases, the FactorySuite applications have even identified problems that the company didn't previously know existed.

Real-World Benefits

As an example, the plant experienced a scrap problem in one area of the graphite-making process. "Scrap levels were high and were costing us many thousands of dollars a year," Little said. "Scrap has now been reduced in the production process because the IndustrialSQL Server and ActiveFactory software help our staff run and monitor processes more effectively. By gathering data directly from process instrumentation, operators can better-identify heating and cooling rates that helped us make equipment and process changes that have reduced scrap to almost nothing."

In another case, the new system helped engineering staff diagnose a machining flaw that had gone unnoticed for years. They connected an electronic micrometer to the IndustrialSQL Server historian and began retrieving precise measurements of every electrode's diameter.

"Using parametric queries to view the diameter profile of individual electrodes, we were able to identify that we were turning down our electrodes at a very slight taper," Little noted. "Although this taper caused no quality

defects or performance problems for our customers, it meant that electrodes weighed several pounds less than they would have had there been no taper. In an industry that buys and sells electrodes by the pound, this difference led to a greater than $30,000 cost savings annually. And we now know that every electrode we make is right on spec."

Another essential feature in a batch process environment is visibility into the equipment's operational characteristics on one graph.

"The IndustrialSQL Server and ActiveFactory software gave us the ability to easily create multi-axis graphs that could display several tags per axis, which meant we could now compare the specific performance parameters of certain equipment and see their effects on the process and product quality," Little said. "We learned, for example, that different furnaces are better suited for certain product mixes, so we schedule our production accordingly and make optimal use of our major equipment and facilities."

The IndustrialSQL Server historian is also critical for collecting and maintaining environmental compliance data. Carbon dust control is critical throughout the plant, so Showa Denko maintains 18 "bag houses" around the facility for filtering and controlling dust emissions.

"It used to take a minimum of three hours every day for staff to climb the baghouse equipment, take filter readings and then fill out manual reports in the office," explained Hoyt Von Kaenel, Environmental Technician. "This data collection is now automated using the IndustrialSQL Server historian to gather live data on a 24x7 basis and the ActiveFactory software is used to produce air quality history reports for various state and federal environmental agencies.

"On the cost-reduction side, we've been able to extend the life of our bag house filters, which has saved us thousands of dollars," Von Kaenel said. "We're now able to reliably predict when the filters are used up and need to be replaced, rather than changing them at regular intervals whether they need it or not. We can also analyze our historical data to predict equipment-performance issues that might lead to major equipment problems before they occur. This helps us better budget our maintenance activities."

The staff has also found that environmental audit processes go much more smoothly because of the historical data that the IndustrialSQL Server software provides.

"We also get better annotations for calibrating our instruments," Von Kaenel added. "Our state regulators are impressed with the data we give them during the audit process. Questions are answered more quickly and readily, and proof about how our equipment is acting is right there on the monitor."

Intangible Benefits

There are also intangible benefits to the FactorySuite system .

"Since all screens and data can easily be viewed live, if there's a particularly knotty production problem to be resolved, plant staff can meet in the conference room, bring up the screens and data in question, and view them using an LCD projector – allowing the plant 'brain trust' to collaborate on the best possible solution, in real time," Little said.

"The benefits of this program have been wide-ranging and numerous, including our ability to analyze the data displayed, apply cost-saving measures and increase the information flow up and down the company chain, providing a better understanding of the plant's operating conditions," added Andrew Nielsen, Vice President of Operations.

"In addition to the tangible benefits we've received, there are many intangibles we've realized from this project, as well. This includes the means for all plant data to come through one open and easy-to-use interface, which results in reduced training, and being able to push data out to the plant floor using a thin-client intranet interface. This helps reduce maintenance and updating of PC-based workstations through thin-client technology. We feel it's the combination of both tangible and intangible benefits that have provided Showa Denko Carbon with a healthy return on its investment within the first year of this project's operation."

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