Control system upgrade boosts annual productivity by 350 tons—an additional US$1.3 million in annual revenue

At Formosa Taffeta's tire cord plant, a modernized control system breathed new life into an aging hot-dip machine. The upgrade increased productivity, improved product quality, and extended machine life, while dramatically reducing waste and costly downtime, increasing profits by US$100,000.

Background

Established in 1973, Formosa Taffeta Co. (FTC) Ltd. is a member of the Formosa Plastic Corporation conglomerate, the leading plastic manufacturer in Taiwan. FTC is a preferred supplier to many of Taiwan's textile product manufacturers, and is widely recognized for its state-of-the-art weaving, dyeing, printing, and finishing processes.

FTC's Second Business Division produces tire cord fabric, which is used by companies such as Goodyear and Bridgestone to produce tires for bicycles, motorcycles, automobiles, trucks, and mobile cranes. Employing the latest machinery and equipment from around the world, the tire cord plant produces 3,200 tons per month at maximum capacity, primarily for Asian, Australian and American markets.

Tire cord fabric is created from fabric yarn, which is obtained from Formosa Chemical & Fiber Corp., another member of the Formosa Plastic conglomerate and woven into fabric cloth at the plant. To produce a high-quality liner that can be used in rubber tires, the fabric cloth is treated chemically using a hot-dip process. The Hot-Dip and Stretch Line machine is responsible for this process, dipping the fabric into chemical compounds, drying and curing it in its ovens, and coiling it up in rolls.

Challenge

To ensure the hot-dip process delivers a consistently high-quality product, stable tension and steady line speed are critical. When tension is too loose, the wet fiber cord sticks together; when it is too tight, the cord becomes stretched and becomes waste. Inconsistent line speed causes the dipping process to become uneven and the exposure time in the oven to become inconsistent, which affects the fabric cloth quality and also results in waste. FTC required a reliable and stable machine that was easy to operate and maintain.

However, the Hot-Dip and Stretch Line machine was twenty years old and had become increasingly unstable and unreliable, making it difficult to keep up with production schedules and meet quality requirements. The machine was prone to frequent and sudden shutdowns and parts were often very difficult to find. Completing repairs took from several days to as long as two weeks.

Employing obsolete relay-logic, analog technology, the machine had become increasingly difficult to control. Tension and line speed often became unstable, resulting in poor quality product and waste. Over time the contacts and mechanical moving parts of the relay wore out and would stick. The resistors

and capacitors on the printed circuit board of the analog controller would often drift, but the internal circuitry was inaccessible and diagnostic tools did not exist, making repairs extremely difficult. Also, the lack of parts availability contributed to long periods of costly downtime.

The motor-generator set that was used to control the speed of the production line motor had also become obsolete and imprecise, causing production speed to vary widely: 3-5% compared to 0.1-0.5% of newer digital thyristor controllers. Plus, with high energy costs and frequent maintenance requirements, the motor-generator was expensive to operate.

In addition, drawings for the machine are either missing, incomplete, or incorrect, and diagnostic tools don't exist. As a result, young technicians and engineers could not work on the machine, so FTC has had to rely on senior engineers in the plant who have experience with analog systems and motor-generator sets. When these engineers couldn't troubleshoot and repair the machine, engineers from the OEM had to be called in from Germany, causing even longer shutdown times.

Solution

FTC turned to Rockwell Automation Taiwan Global Manufacturing Solutions group to recommend a solution. The OEM also submitted a bid to refurbish the machine, but their cost was 50% more than Rockwell Automation's and the shutdown time required to implement the solution was twice as long.

Rockwell Automation proposed replacing the hot-dip machine's outdated analog control system with a state-of-the-art digital control system. A digital control system would increase the controllability and stability of the machine, while making it easier to operate and maintain. FTC accepted Rockwell Automation's proposal and the project commenced on September 7, 2000. Rockwell Automation was involved in every aspect of the project, including technology upgrade/field modernization, system design and implementation, site installation, startup, and post-startup support including on-site training.

The tire cord plant was shutdown for installation and commissioning from December 13 to December 27, 2000. The new system became operational on December 28, 2000. After two weeks of punch list correction and fine tuning, the machine was fully functional to all operational requirements by mid-January 2001.

Rockwell Automation installed a state-of-the-art control system to control the line speed and line tension, to calculate the oven exposure time during the curing process, and to coordinate line sequencing, with Flex I/O for remote access.

Seven Rockwell Automation FlexPak 3000 digital DC drives and two GV3000 digital AC drives are connected by network to the master PLC, making it easier to operate and maintain.

To control costs, the original DC motors were used. Because no cables or motors on the machine needed to be installed or aligned, shutdown time was reduced by five days to a week. Rockwell Automation also installed two Smart Motor Controller PLUS motor starters for oven fan control.

The new system is monitored by a PanelView 1000 color terminal. Using this graphical interface panel with Chinese character screens, operators can easily program all production parameters including line tension, line speed, and oven exposure time as well as perform operation control of the machine. The HMI also provides line status, operations interlock status, motors status, alarm/faults, and troubleshooting and diagnostic information.

Results

Digital control has made the machine much easier to operate and maintain, resulting in higher productivity levels. The plant produced 350 more tons of fiber cord in 2001 than the previous year, generating an addition US$1.3 million in revenue.

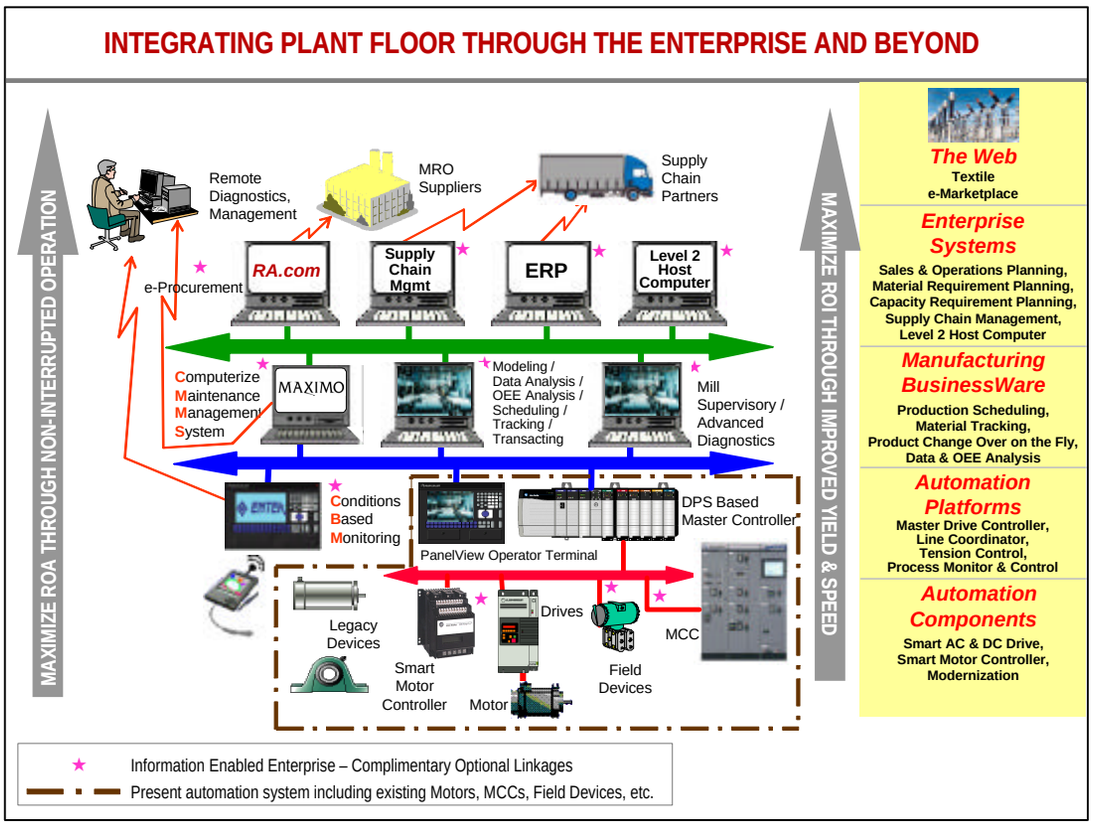
Costs have been significantly reduced as well. Unpredictable shutdown

and machine downtime have been minimized, while waste material has been reduced due to more stable production. By increasing productivity, reducing waste, and saving on electricity, the plant was able to increase profits by US$100,000 in 2001.

Production schedules and product quality are now much easier to control. Line speed is far more consistent. Exposure time of fiber cord in ovens is well controlled for different line speeds and materials. Increased stability means fiber is less likely to stretch and stick due to fluctuation in line tension. The result is a consistently higher quality product.

The upgrade also extended the life of the machine by ten to fifteen years, according to C.F. Hsieh, tire cord plant manager. "We imported this machine from Germany 20 years ago, and it was really starting to show its age," says Hsieh. "We are very fortunate that Rockwell Automation Taiwan was able to cost-effectively modernize this machine and extend its life. They also helped us resolve a lot of operation and maintenance problems, which has helped us reduce costly downtime and eliminate waste."

The architecture below depicts Rockwell Automation's concept of an Information Enabled Enterprise. The area outlined with a brown dash line represents the present automation level under discussion in this document. The remaining portion illustrates a host of solutions that Rockwell Automation can provide today to integrate the plant floor to the enterprise and beyond.



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