



YASKAWA

Application Report Textile Facility Rebuilds

During what seemed an incredibly few moments in December of 1995, a raging fire heavily damaged three major buildings at the Malden Mills, complex in Lawrence, Mass.

Malden Mills manufactures its line of Polartec® and Polarfleece® branded products for producers of outdoor apparel, home furnishings and footwear.

Production is carried out on dyeing, drying, annealing, shearing, tenting and other production operations regulated by a variety of AC variable frequency drives.

Within less than a month, Malden Mills management had organized a team of architects, engineers and builders with the task of designing and constructing a new facility with a completion date of February, 1997.

Eight months from the beginning of construction, on schedule and fifteen months after the fire itself, the first elements of the new facility went into production. The new, state-of-the-art manufacturing facility was fully operational in September, 1997.

Rebuilding With World-Class Technology

Much of the reconstruction team's effort centered on determining equipment needs and evaluating potential suppliers on the bases of capabilities, quality and service.

As is the case in many existing textile operations, much of their equipment had been serviceable but outdated. For instance, process control in manufacturing operations had relied on a series of ac motors regulated by combinations of clutches, belts, and pulleys.

The operation had been functional but offered little in terms of accurate tension and speed control or the capability to duplicate even frequently-used control parameters.

It was apparent that much of the plant upgrade would need to center on application of new drive technology. Technology that would incorporate precise process and production control techniques and would allow operators to key in production parameters as simple "recipes" during frequent production changeovers.

The Selection Process

Selection of nearly 200 drives for installation in a variety of process systems throughout the new plant required the reconstruction team be brought up to date on available drive technologies in a short amount of time.

It was determined that this process could most easily be accomplished by observing various drives, systems, and process communications schemes at work on similar applications. Tours of several manufacturing facilities in the Southeast were arranged by systems integrator R.A. Moore, Inc., Charlotte, N.C.

During the tours, Malden Mills project engineers received on-site demonstrations of drives in operation under production conditions comparable to those projected for the rebuilt Lawrence mill. Included were several facilities where R.A. Moore had applied its broad experience in design and installation of drives and systems in a variety of textile and range installations.

Drives observed by the Malden Mills team ranged from sophisticated models offering three-level control through 32-bit microprocessor to provide volts/hertz, closed or open loop vector control, to simple variable frequency ac drives for conveyors and feed lines, pumps, air circulation and exhaust blowers.



The Malden Mills' team compared drives and suppliers. Selections were based on the previously-mentioned standards, along with the suppliers' ability and willingness to provide factory and on-site training and service, and its ability to meet Malden Mill's tight delivery schedules.

Yaskawa Electric, New Berlin, Wis., was selected to provide the variable frequency drives which would be required for the diverse applications in the modern new production facility.

Modern Drive Technology

Modern ac drives provide the user with the flexibility to utilize traditional volts/hertz, closed-loop flux vector or advanced sensorless (open-loop) vector speed control. Combination of these effective control schemes in one drive allows the user to select the control technique that provides the best performance in his specific application. Additionally, all three modes use the same operator interface.

Incorporation of 32-bit RISC microprocessor provides all-digital control, serial communications and repeatable settings in the face of variable line voltages. Torque control and performance are also improved, with 150 percent starting torque available and 100 percent torque continuously available at zero speed in the vector mode.

Today's drives also include fault diagnostic software, reduced harmonic distortion, overtorque detection for motor protection and power loss ride-through. DC injection braking is also available to protect motors during quick stops.

As in the plants observed on the R.A. Moore tour, the drives selected range from highly-sophisticated open and closed loop vector models to traditional variable frequency varieties, with each drive matched to a specific application.

This step to modern drive technology has provided Malden Mills with levels of control technology that were largely unheard of ten years ago.

Attributes which were particularly important in operations on which Malden Mills was to apply its drives included:

- Speed/torque selection on the fly
- Accurate speed control (regulation)
- Excellent torque control
- High starting torque capability
- 100 percent torque at zero speed
- Wide speed range operation
- Relative positioning capabilities
- Speed limiting capabilities

Some of the more complex machines in the Lawrence operation are Malden Mills "tenterers," which are used to set fiber, color and shape during the drying process. A typical tenter utilizes a combination of 15 drives.

According to Paul Fleming, Senior Project Engineer, the most sophisticated drives are operating in a closed-loop vector "speed" mode with encoder feedback. In this mode, drives like Yaskawa's are able to provide speed regulation of better than .01 percent, with digitally repeatable entry of parameters for ease of programming and quality control.

At Malden Mills, such drives are used to regulate jet dyeing speed, feeders, folders, slitters, conveyors, pull rolls, squeezing units, vibrators, shears and other such demanding textile process machinery.

They also regulate the speed of pin chains which set lateral size and feed rollers which carry the stock through the tenter screen.

Other variable torque drives operating in a V/Hz speed mode regulate circulation and exhaust fan speeds to maintain a critical balance of humidity and temperature during the drying process.

Required fan speed is entered through the drive's digital keypad and continually compared to readings provided by a humidity sensor. The tenter is gas-fired and segmented into eight zones with two burners per zone. Speed and humidity are balanced by varying fan speed, dryer roll speed and temperature.



These individual/sectionalized ac drives replaced one large main motor and an old-fashioned tapered-pulley mechanical drive system. In the new installation, each roller has its own motor and gear drive assembly, providing much more accurate control and reduced maintenance.

Variable frequency drives are also used to regulate speed on lifter reels within the dye jets. Fabric is passed through the washer and repeatedly rinsed by high-pressure jets so that colors will properly set. Regulation of these rollers is by speed. Dye jet washer pumps are regulated through a PID Loop, monitoring flow rates based on process requirements which are entered into the drive's key pad.

Flexibility Via Software

The ability to make adjustments through software rather than expensive mechanical hardware provides savings on installation and maintenance. It also provides flexibility for easy changeovers in operations such as Malden Mills, where the average run is about three hours. The flexibility of the Yaskawa drives simply let the operators dial in "recipes," reducing wasted, unproductive downtime.

According to Fleming, the drives provide the ability to view and change parameters while running "We couldn't do this before," Fleming said. "Their repeatability lets us enter parameters like recipes. That's very important on tenderers, where achieving the correct ounce weight is critical for quality product."

"State-of-the-art, flexible, programmable ac drives have provided us with easier maintenance, reduced downtime, repeatable operating parameters and improved product quality."

"Yaskawa provided our technical and maintenance people with product training, allowing us to become self-sufficient on the drives," according to Vincent Doyle, senior electrical technician for Malden Mills.