Case history

Upgrading a packaging operation with an automated bagger and robotic palletizer

A corn mill automates its bagging and palletizing line to improve production rates and decrease labor costs.

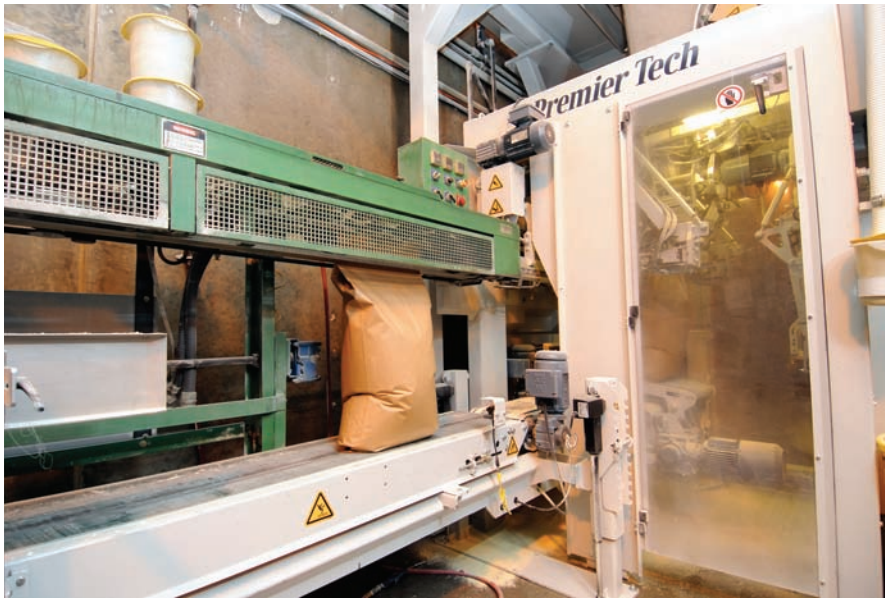
Agricor Inc., Marion, Ind., has been producing dry milled corn products since 1983. The company buys yellow corn from local farmers and grain elevators and mills it into degerminated corn grits, cornmeal, and corn flour. The products are packaged in bulk containers, such as bulk bags and hopper cars or 50- and 100-pound bags, and shipped to various US, Canadian, and international companies for use in food and industrial products. In the past, the company manually bagged and palletized the small bags. However, this method was inefficient, labor-intensive, and dusty, so the company decided to automate it.

Packaging different products

The company annually mills more than 5 million bushels of corn into corn grits (a coarse granular product), cornmeal (a finer granular product), and corn flour (a fine powder). Because each product has a different bulk density and volume, the company uses three sizes of 100-pound bags and two sizes of 50-pound bags when bagging the various products. The corn grits are put in what the company calls a 100-pound regular bag, the cornmeal in a larger 100-pound bag, and the corn flour in an even larger 100-pound bag. The company also packages the corn grits and cornmeal in a 50-pound regular bag and the corn flour in a larger 50-pound bag.

In the past, manually bagging and palletizing the products required four to six operators per shift, depending on the bag size being filled. One operator moved filled bags through a bag sealer, one to three operators stacked the filled bags on a pallet, one operator cleaned up any spillage and dust and refilled the bagger's empty-bag magazine, and one operator drove a forktruck that moved full pallets to the warehouse.

To bag a product, an operator first loaded the bagger's empty-bag magazine with the appropriate bag size, set the bagger's scale to weigh out the appropriate product amount, and started up the bagger. The bagger automatically placed an empty bag on the bag-filling spout, weighed out the product (which had passed through an inline rare earth magnet to ensure product



The outfeed conveyor moves a filled bag from the automated bagger through the bag-sealing system, which automatically seals the bag shut and minimizes fugitive dust in the plant.

purity), dropped it into the bag, and released the full bag from the spout onto a conveyor. The conveyor moved the full bags to the bag-sealing station, where an operator fed them through the sealer. The sealed bags were then conveyed to a palletizing station, where operators positioned them on a pallet in a stacking pattern determined by the bag size. To ensure that the bags loaded onto the pallet met weight requirements, an operator placed the first bag for each pallet on a platform scale to check the weight and then, if necessary, adjusted the bagger to either fill less or more product into the subsequent bags.

Experiencing bagging and palletizing problems

When manually bagging and palletizing the various products, the company was able to produce 100-pound regular and cornmeal bags at 5 bags per minute, 100-pound flour bags at 3 bags per minute, 50-pound regular bags at 7 bags per minute, and 50-pound flour bags at 4 bags per minute. However, to maintain this production

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The robotic arm's finger gripper can easily handle multiple bag sizes, from 9 by 13 by 1.5 inches up to 23 by 39 by 6 inches.

level and continue meeting customer demand, the company typically had to operate three shifts a day, 6 days a week, and hire up to two temporary employees per shift.

"We basically threw labor at the production problem," says Jack Jones, Agricor warehouse and packaging supervisor. "For the one-hundred-pound bags, we had one operator using a machine that assisted with the pallet stacking. For the fifty-pound bags, we needed two operators manually stacking them, and in busier packing periods we'd use three operators. To minimize the risk associated with manually handling so many bags, during each shift we routinely rotated the operators through the bagging and palletizing line's operating stations. Looking back, we were very fortunate not to have had any ergonomic issues while manually handling so many bags, but it was always something we worried about."

According to Steve Wickes, Agricor president, another problem was that "the bagger's filling accuracy varied quite a bit, with the corn grits and cornmeal varying about one pound from the set bag weight and the flour varying considerably more than that. And since we typically erred on the side of overfilling the bags, we were losing product with nearly every bag we filled, which cut into our profit margin."

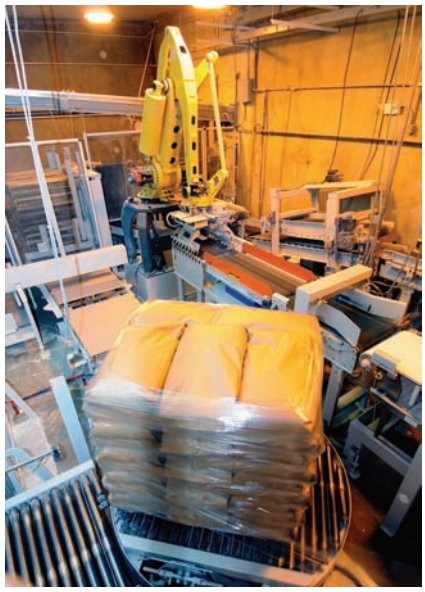
The company needed to improve its bagging and palletizing operation, especially if it wanted to continue increasing its customer base. "We couldn't increase production because we were already operating the packaging line at full capacity, so we were basically at a standstill," says Wickes. "We also needed to improve bag-filling accuracy to minimize product loss, and we needed to decrease the number of operators and time required to bag and palletize the products. So we decided to completely automate the packaging line and upgrade the metal detection equipment to better guarantee product purity."

Looking at automation options

Wickes and Jones contacted various bagging and palletizing equipment suppliers. "We told them we were looking for an automated bagger, bag sealer, and robotic palletizer that could handle all three products without requiring time-consuming adjustments between product runs," says Jones. "We also told them that the packaging line's equipment would be installed in an area with limited floorspace and that they would probably have to custom-design the conveying line and equipment layout to fit everything in that small area. Additionally, removing the old equipment and installing the new had to happen within a very short timeframe because we had to maintain our production schedule. Basically, the supplier only had two consecutive weekends, or about ninety-six hours, to install the entire packaging line."

Among the competitive bids, one stood out after Wickes and Jones compared the various elements of each proposal. "We looked at each supplier's installation and equipment costs, equipment quality and system design, and project management philosophy and follow-up service and concluded that only one supplier had the package best suited for our application and budget," says Wickes. "Before we made our final decision, we sent all three products to the supplier's test facility for testing, and we visited one of their installations in Toronto and talked with another one of their customers in Saskatchewan. The tests showed that their bagger could easily handle our three products, and we only received positive feedback from the customers we talked with, so we decided to purchase one automated open-mouth bagger with an automatic bag sealer and one programmable robotic palletizer from the supplier."

The supplier, Premier Tech Systems, Rivière-du-Loup, Quebec, designs and manufactures customized automated packaging, palletizing, dosing, and stretch-wrapping equipment and systems for handling dry bulk solids.



The packaging line's stretch wrapper automatically wraps and secures a completed pallet for transport.

The automated bagger and robotic palletizing cell

The PTK-1700 series high-speed bagger bags powdered or granular materials, including minerals, chemicals, foods, and animal feeds, into open-mouth paper, PE, and woven PP (pillow-type or gusseted) bags at rates up to 25 bags per minute, depending on the bag size and material. The bagger's modular platform can be configured to suit various applications, and its typical layout requires about 154.5 inches (3,925 millimeters) by 199.75 inches (5,080 millimeters) of floorspace and 101 inches (2,565 millimeters) of headroom. The bagger has all stainless steel material contact surfaces and provides dust-free bagging with total bag control for hygienic and food-grade applications. It also provides quick and reliable transfer of filled bags to the automated bag-sealing system.

Designed for use in dusty environments, the bagger is powered by TEFC (totally enclosed fan-cooled) electrical motors and uses an Allen-Bradley control system that's housed in a NEMA 12 cabinet. The bagger's PLC has a user-friendly touchscreen operator interface that allows easy troubleshooting and

error code reading, and its self-diagnostic software has emergency stop interlocks to ensure operator safety during operation. The bagger's integrated scale-control system consistently provides accurate material weighments, and its multiple-stack bag magazine allows fast reloading and quick bag-size changeovers.

The AR-200 series robotic palletizing cell can simultaneously gather bags from up to four different product lines and palletize up to 28 bags per minute, depending on the bag characteristics, pallet height, layout configuration, and other factors. For Agricor's application, the supplier configured the palletizer to gather bags from only one product line because of the limited floorspace. With this configuration, the palletizing cell's typical layout requires about 418 inches (10,617 mm) by 371 inches (9,423 mm) of floorspace.

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A PLC with a user-friendly operator interface that uses a color graphic teach pendant is located on the robot controller and shows 3D equipment and layout drawings for easy operation in manual mode. The interface also shows stored recipes that an operator can quickly access for changing the bag size and palletizing pattern. When programmed to create a 40-by-48-inch (1,000-by-1,200-millimeter) bag layer, the palletizer can make a full-pallet load with bags stacked up to 104 inches (2,640 millimeters) high. The palletizer can create a bag layer up to 60 by 72 inches (1,525 by 1,830 millimeters) and has a maximum load capacity of 4,400 pounds (2,000 kilograms).

The automated palletizer automatically places empty pallets and slip sheets, and its robotic arm has a finger gripper equipped with an automatic bag-width adjustment system. This allows it to easily handle bag sizes from 9 to 23 inches (230 to 585 millimeters) wide, 13 to 39 inches (330 to 990 millimeters) long, and 1.5 to 6 inches (40 to 150 millimeters) thick, and bag weights up to 176 pounds (80 kilograms). The robotic arm can also be fitted with custom grippers for handling bundles, bales, boxes, cases, and other containers.

The palletizing system's PLC uses collision-guard software to prevent accidental damage to the robotic arm's gripper and other equipment. And several 8-foot- (2.4-meter-) tall safety fences with interlocked access doors surround the palletizing cell to ensure operator safety during operation. These and other safety features ensure that the robotic palletizing cell complies with ANSI/RIA 15.06 and CSA Z-434-03 safety standards.

Installing the packaging equipment

The company hired a local millwright (Industrial Maintenance Specialists) and electrical contractor (Rex Collins Electric) to install the new equipment. On Friday night, February 15, 2008, the millwright crew, along with the supplier's engineers and Agricor's operators, began removing the old bagger from the plant. "We took out the old bagger and put in the new one," says Jones, "and the next weekend we installed the robotic palletizer, conveyors, and the other equipment. We met our installation timetable both weekends and were up and bagging product each Sunday night. It was an impressive performance because everything had to be installed right on the money; we had no space to spare. In fact, there's only three inches of space between the equipment and one of the walls; that's how tight the whole system is."

To bag a product using the new automated packaging line, an operator first loads the empty-bag magazine with the appropriate bags. The operator accesses the bagger's PLC and calls up an appropriate recipe for filling the bags, and then accesses the robotic palletizer's PLC and calls up the same recipe, which tells the palletizer the stacking pattern to use when stacking the bags.

After the operator starts the packaging line, the bagger's pickup unit lifts an empty bag from the empty-bag magazine. The empty bag is straightened and placed onto the dust-tight filling spout. A settling device helps deaerate the product while the bag is being filled. The filled bag is transferred to the outfeed conveyor, which moves it to the bag-sealing system and inkjet printer.

The bag exits the sealing system and a 90-degree kicker lays it down bottom first, so the bag is flattened before being conveyed across a checkweigher and then through an inline metal detector. All bags outside the preset accuracy range are automatically removed from the system. "We removed the rare earth magnet and now every filled bag goes through the metal detector," says Wickes. "If the detector senses anything, it shuts down the entire packaging line so we know the exact bag that has something in it. We remove the bag from the line and dump the product through the rare earth magnet to find out what set off the detector and whether we need to check upstream equipment for a missing bolt or part. It's much more efficient and effective to do things this way."

After the bag exits the metal detector and the conveyor moves it to the robotic palletizing cell, the robotic arm's gripper removes it from the line and stacks it on a pallet in a preprogrammed pattern. Each bag size has a different stacking pattern and height.

The 100-pound bags are stacked 3 bags per layer, 8 layers high, while the 50-pound bags are stacked 5 bags per layer, 10 layers high. To ensure pallet stability, the robotic palletizer alternates the stacking pattern of each layer.

Once the pallet is completed, it's conveyed to an automatic stretch-wrapper, where it's wrapped and secured for transport. The stretch-wrapper has a photo-sensor eye that detects the pallet height so it knows when to stop wrapping the pallet.

The company now requires only three operators per shift to run the packaging line — one watches over all of the machinery, one cleans, and one runs the forktruck. Currently, the company is bagging 100-pound regular and cornmeal bags at a rate of 9 to 11 bags per minute, 100-pound flour bags at 7 to 9 bags per minute, 50-pound regular bags at 15 bags per minute, and 50-pound flour bags at 8 to 10 bags per minute. The bagger has a filling accuracy range of ±4 ounces for all bag sizes. And even though the atmospheric humidity level can affect the flour flowrate because the flour absorbs moisture making it stickier and slowing it down, it doesn't affect the bagger's weighing accuracy.

Improving the company's packaging operation

Since installing the new automated bagging and palletizing line, the company has significantly reduced its operating and labor costs. "The new packaging line bags the products so fast we only have to operate two shifts a day, five days week to maintain our production schedule," says Wickes. "And the robotic palletizer has decreased our labor costs because we longer need to hire temporary employees during the busy season to palletize fifty-pound bags. It also eliminated potential ergonomic issues related to operators manually handling so many bags."

The bagger's weighing accuracy has improved the company's profit margin by decreasing product loss. "We're very pleased," says Jones. "The bag-weight accuracy range is really tight, and our customers are happy because they get exactly the amount of product they order. Also, the new metal detection equipment has improved our peace of mind because we know we can guarantee our products' purity."

The bagger's dust-collection ports can be connected to a dust collection system, so that as a product moves through the filling spout into a bag, a release tube connected to the dust collector sucks out all of the displaced air and dust generated during filling. "This has improved the plant's working environment and decreased housekeeping costs because there's less fugitive dust in the air," says Jones. "Any product collected by the dust collector is no longer food-grade quality, but we sell it for animal feed, so we see a cost benefit there, too. The plant is also much cleaner because the bag sealer consistently seals the bags and the packaging line produces fewer broken bags than the old line."

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Both Wickes and Jones have been satisfied with the supplier's post-installation operator training and follow-up service. "The supplier's engineers were very good about training our operators on the new equipment and really got us up to speed," says Wickes. "And even though it's been a huge learning curve because the technology is still relatively new to us, the longer we operate the system, the better we get at it. The supplier has also been easy to work with and very responsive. If something ever goes wrong, their tech support is available until ten at night, so we can call them up and get answers over the phone, and that's been very helpful." **PBE**

Note: To find other articles on this topic, look under "Bagging and packaging" in *Powder and Bulk Engineering*'s Article Index at www.powderbulk.com or in the December 2008 issue.

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