CONTRACT PACKAGING

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Robots finish mac and cheese line

A multi-axis ARBOT palletizer forms layers of shrink-wrapped trays on a pallet and then hands the pallet off to a stretch wrapping cell where corner boards are also placed robotically.

By **Pat Reynolds**,
VP/Editor, *Packaging World*

▲ **ROBOTIC APPLICATION.** Protective corrugated cornerboards are applied automatically by this robotic system just before stretch wrap is applied to the pallet.

A contract manufacturer and packager that specializes in cartoning mac and cheese, Philadelphia Macaroni Co. has manufacturing operations in Grand Forks, ND, and Spokane, WA, in addition to its headquarters operation in Philadelphia.

Grand Forks is the largest of the three plants. Annual capacity is in the range of 90 million pounds. This past summer the plant emptied about 25,000 sq ft of warehouse space (a 60,000 sq foot warehouse is under construction) to make way for a second high-speed mac and cheese cartoning line that now operates beside an existing line populated by similar, though older, equipment. Much of what is packaged on both of the lines is under the popular Annie's Home Grown brand.

"What it came down to is that volumes were growing and we needed a second line," says VP of Operations Frank Radano. "But we wanted the new line to have more functionality and run at higher speeds."

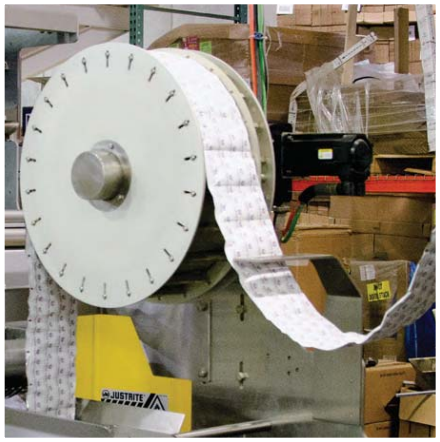
The new line, used most of the time for paperboard cartons whose net weight is about 170 g, has a number of upgrades compared to its 10-year-old counterpart. Especially well designed, says Radano, is the end-of -line portion: dynamic lane dividing, case/tray packing, robotic palletizing, robotic corner board application, and stretch wrapping. Each of these machine functions is executed by a machine from ARPAC (www.arpac.com). ARPAC, as the OEM integrator, provided seamless integration of the entire end of line packaging operation, including conveyance and controls.

"The ARPAC team did a great job of making it all fit, making it run smoothly, and helping us with various questions we had on handling various case and tray sizes," says Radano. "They were always responsive to any issue that surfaced."

Key differentiators separating the older line from the new one include these:

- While the older line tops out at about 300 cartons/min, the new line routinely does 350-400/min
- X-ray inspection is used for metal detection.
- Shrink-wrapped corrugated trays and wraparound corrugated cases are palletized by a robotic system as opposed to an overhead palletizer.
- Protective corrugated corner boards are applied robotically rather than manually.
- The vertical cartoner that puts pouched cheese and pasta into the cartons is primarily servo controlled while its predecessor was more mechanically oriented.

If, as Radano says, "more functionality" was a key deliverable that his firm was after as the new line was designed, they got that and more in the end-of-line robotics that are the highlight of the line. The ARPAC ARBOT palletizing cell not only builds pallets, applies cornerboards robotically, and applies pallet wrap. It also makes operation



▲ **AUTOMATIC SPLICING.** Roll-fed film used to put powdered cheese into pouches is automatically spliced by the machine shown above. Exiting the pouching machine, cheese pouches are in bandolier format (at right).

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easy on the operator.

"The key to any robotic packaging application is to make everything as simple as possible for the operators, the ones who encounter the equipment day in and day out," says Paul Moore, Director of Robotic & Integrated Systems at ARPAC. A good example of this simplicity in action is the automated application of the corrugated corner board to pallet loads of cases prior to application of pallet stretch wrap.

"The first thing the robot has to do in each cycle is pick the cornerboard and then position it in front of an adhesive applicator," says Moore. "If anything at all goes wrong with that adhesive application, rather than requiring an operator to have to get into a robot's program or use the robot's teach pendant, we write all of the information to a Rockwell HMI that makes it easy for the operators to control the robots. They can jog the robot or jog the stretch wrapper with buttons on the touch screen. So our programmers make it very easy for an operator to control the robotic cell and recover from ordinary operating errors that may occur."

Moore says he's seen significant progress in that interface space between the Arpacs of the world and the Yaskawas and Fanucs and Kukas of the world. Integrating the robot with the packaging machine is considerably improved.

"It's really the quality of the integrator that often dictates how smoothly this interface goes," he points out. "And remember, it's not like an automotive plant where, because 350 robots are installed, that plant houses a lot of experts when it comes to robotics. What we try to do is put as much control in the Rockwell HMI as possible. We try to make it intuitively obvious to the operator so he can index products through the cell and recover from errors that might arise because of bad packaging materials, for example, whether it's the pallet wrap or the corner boards or the slip sheets or whatever."

Pouching comes first

At the head of the packaging line is a Pouch King pouching machine from R.A. Jones (www.rajones.com). Operating at speeds of 500/min, it takes a roll-fed paper/foil material and forms it into pouches that are filled with a powdered cheese mixture. Automatic splicing of the pouch rollstock is provided by a Butler Automatic (www.butlerautomatic.com) machine. Filled pouches exit this Jones machine in a bandolier and are cut into individual units that drop into a flighted conveyor that leads to a tilt-tray insertion station above the vertical cartoner from PMI Cartoning (www.pmicartoning.com).

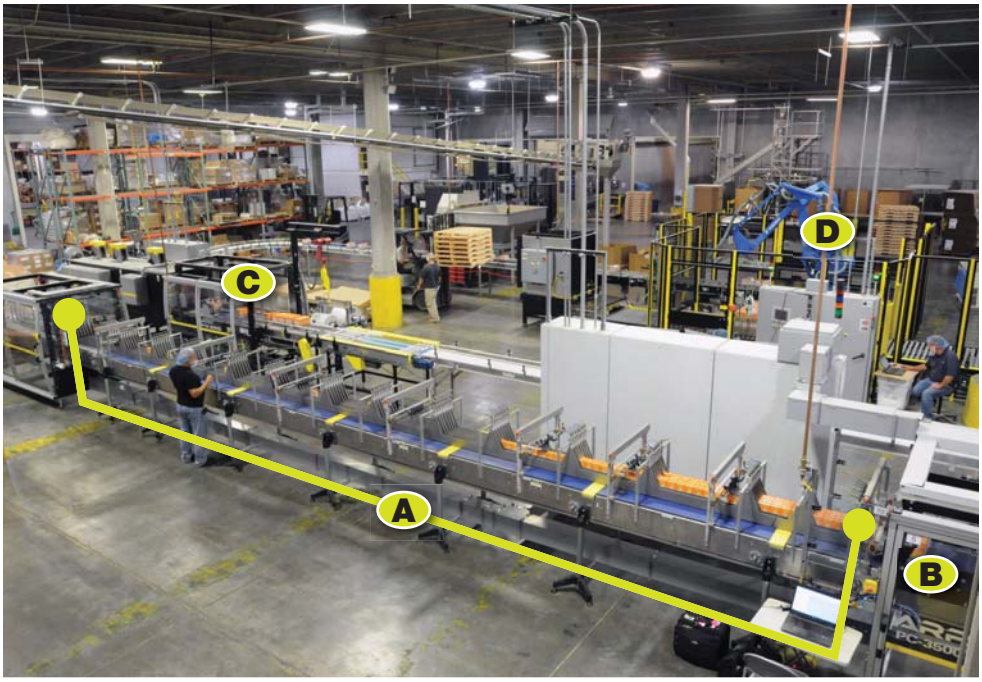
The ability of the pouching system to run faster than the downstream cartoner means that a buffer of pouches can be

accumulated. These accumulated pouches can then be sent into the cartoner if the pouching machine pauses while a film splice is being made.

A date and production code is ink-jet printed on the pouches by a Videojet (www.videojet.com) system just before they are cut free from their bandolier. A second Videojet printer is used to mark pouches produced just before and after a splice takes place so that the pouches produced during splicing can be removed.

In the Model VXL2-6 cartoner from PMI, side-seamed cartons are taken one by one from a horizontal, powered, 15-ft capacity carton supply magazine. Each carton is picked with vacuum and formed into a carton pocket fixture by a rotary carton feeder. The carton pocket fixtures move continuously along an oval-shaped track so that cartons can be filled with a cheese pouch and pasta from above.

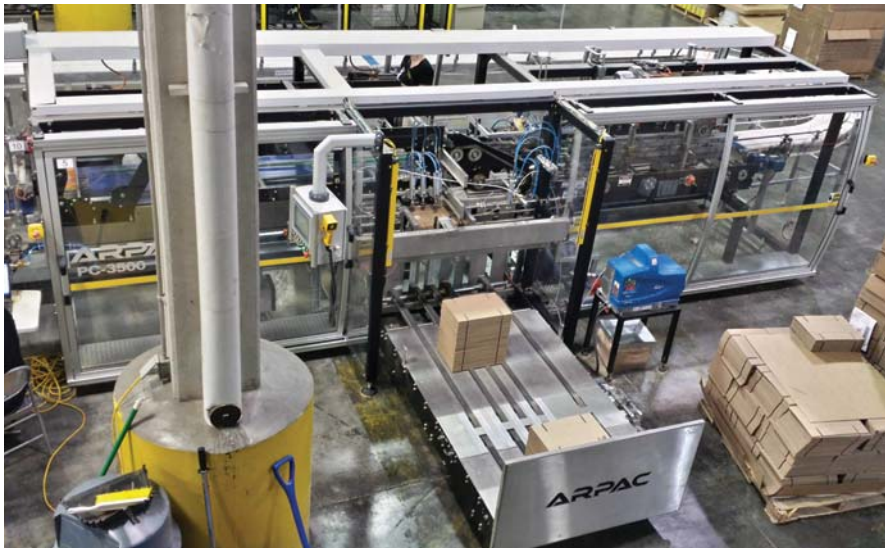
Shortly after a carton bottom is tucked and glued closed by the Nordson (www.nordson.com) ProBlue10 glue system, a pouch of cheese drops in from an overhead tilt tray. Then pasta is dosed volumetrically by a 15-cup volumetric filler. Each volumetric cup measures the pasta, and as a carton is detected below, a gate is opened so that product can flow into a reciprocating servo-driven transfer spout. These transfer spouts, moving continuously along the oval spout assembly and closely mated with the tops of the cartons, deliver pasta into the cartons. As cartons are filled, vibration is used to settle the product. Product fill is inhibited when a carton is not detected in the carton pocket fixture, so no carton/no product fill is maintained.



▲ **BIRD'S EYE VIEW.** The Bird's Eye view shows dynamic lane divide (A), PC-3500 case/tray packer (B), shrink wrapper (C), and robotic palletizer (D).

When asked why select a PMI cartoner, Radano says, "We like the PMI cartoner we've had on Line One for the past 10 years. We've had no issues with it, and it looks like it did on the day we bought it. Of course the new one is all servo driven." Included in the VXL2-6 cartoner is a PLC ControlLogix processor from Rockwell (www.rockwellautomation.com), and the machine's servo drives and motors are also from Rockwell.

Exiting the PMI system, cartons are uprighted by a Spantech (www.spantechllc.com) conveyor section and move through an X-ray metal detection system from Sapphire (www.sapphire-inspection.com), which was suggested to Philadelphia Macaroni Co. by Sharpe Engineering & Equipment (www.sharpeengineering.com). "We couldn't find a domestic source that could keep up with the speeds we wanted," says Radano when asked why they selected Sapphire.



▲ **CASE/TRAY PACKER.** On the day this photos was taken, the case packer was putting mac and cheese cartons into corrugated trays, but the machine can also produce wraparound cases.

Dynamic lane divider

Next in line is a checkweigher from Thermo Scientific (www.thermoscientific.com), after which cartons move into the ARPAC servo-driven dynamic lane divider. It divides one lane of cartons into four. The four lanes feed an ARPAC Model PC 3500 system that encloses 12, 15, or 24 cartons in either corrugated trays or a wraparound corrugated case. When trays are in produc-

tion, they are next conveyed into an ARPAC BPT-W5300 continuous-motion inline combination shrink wrapping machine. Wraparound cases, on the other hand, simply bypass the shrink wrapping step.

The robotic palletizing cell is next. "We felt a robotic system would give us more accurately formed pallets with better stack integrity," says Radano when asked why opt for robotics. Trays reach the palletizer by way of a Spantech low-back-pressure accumulation conveyor that provides accumulation time in case there is a pause or downtime at the palletizing cell. Integrating the Spantech equipment into the overall end-of-line flow was a critical part of the ARPAC contribution as integrators, says Radano.

One other piece of packaging equipment between tray packing and palletizing is a thermal-transfer print and apply labeler from Weber Packaging Solutions (www.weberpackaging.com) that's equipped with a Zebra (www.zebra.com) print engine. Lot and date code information is all printed on a pressure sensitive label that is then tamped on as a tray is conveyed beneath.

Once trays arrive in the ARBOT palletizing cell, a multi-axis Yaskawa robot from Motoman (www.motoman.com) places them on a pallet. The robot end effector uses a two-zone vacuum plenum to pick and place the cases, which brings considerable flexibility into the kinds of configurations it's capable of. For example, it can pick a full load of four trays and release all four at once on the pallet layer. Or it can place two trays in one spot on the layer and put the other two elsewhere if that's what is needed. The end effector also picks paperboard slip sheets when needed and places them on top of each freshly finished layer.

▲ **VACUUM PLENUM.** Shrink-wrapped corrugated trays of freshly cartoned mac and cheese are palletized by the robot's end effector, whose two-zone vacuum plenum gives it considerable pick and place flexibility.

When a pallet load is complete, that pallet moves on a roller conveyor to the stretch wrap station that is also part of the ARPAC end-of-line solution. But before wrapping takes place, protective corrugated corner boards are applied to all four corners of the pallet. Here, too, ARPAC selected a Yaskawa robot for the task and integrated it into the overall solution. First it picks a corner board from a stack with its vacuum cups and moves in front of a Nordson unit that applies hot melt adhesive to the corner board. The robot then positions itself first in front of one side of the pallet load and then in front of another side. On each side a limit switch is used to learn exactly where that side is in space. This data is sent to the Yaskawa robot controller, which then is able to calculate exactly where in space the corner of the pallet load is. Armed with this information, the controller sends outputs to the robotic arm enabling the arm to place its corner board precisely on the pallet corner.

As impressive as the two tightly integrated end-of-line robots are, ARPAC's Moore says that operating them is intuitively obvious for the people who run them. "The interface software our programmers write ensures that anything the operators need to do is easily done at the Rockwell PanelView HMI," says Moore.

Once all four corner boards are in place, stretch film is applied and the pallet is ready for warehouse or distribution. Radano says protective corner boards have been used on pallets at Philadelphia Macaroni in the past, but never before had they been placed automatically by a robot. This is also the first robotic application of protective corner boards for ARPAC.

"Maybe the biggest challenge with the cornerboards is in adjusting for variations in pallet dimensions," says Radano. "But the solution provided by the ARPAC team is definitely up to the challenge." [CP]