Volumetric feeders help create chocolatey satisfaction

A confectioner installs six volumetric feeders in a new make-your-own candy bar production line to accurately dispense small ingredient amounts into chocolate base bars.

In June 2010, The Hershey Company, Hershey, Pa., opened a new interactive attraction at its HERSHEY'S CHOCOLATE WORLD attraction. Called HERSHEY'S Create Your Own Candy Bar, this hands-on attraction gives visitors the ability to create a customized candy bar with up to three inclusions, operate authentic factory equipment, and design individualized packaging for the candy bar. To make a candy bar, a visitor uses a touchscreen to select the ingredients and starts the production process by pulling a lever. A food-grade belt conveyor then moves a HERSHEY'S milk chocolate base bar under a series of feeders that fill the selected ingredients into the base bar's recessed cavity. After the filled base bar moves through an enrobing and cooling process that seals in the ingredients, it's transferred to the attraction's packaging area, where the visitor selects a custom overwrap sleeve for the completed product. The candy bar is then placed in a carton that's put into a souvenir tin, and the selected overwrap sleeve is placed around the tin, which is given to the visitor at the end of the process. When designing this attraction, the company needed to ensure a perfectly made candy bar for every visitor, so it selected volumetric feeders to consistently fill the various ingredients into the base bars.

Selecting the feeders

Each base bar is about 133 millimeters long by 67 millimeters wide, and its recessed cavity is about 5 millimeters deep and has a volume of approximately 38 cubic centimeters. Since the company planned to allow visitors to choose up to three ingredients, the feeders in the attraction's production line had to be able to accurately dispense each chosen ingredient to fill approximately one-third of the cavity's volume without overfilling it. To maintain efficiency, the fill time for each ingredient had to be less than 5 seconds.

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The volumetric feeders are installed side-by-side in a straight line, and a belt conveyor moves the chocolate base bars from right to left, first under two screw feeders and then under four vibratory feeders.

range of ingredients with disparate particle sizes and flow characteristics," says Krista Cessna, Hershey associate staff engineer. "For this project, we found that gravimetric feeding wasn't an option because of the small ingredient amounts and short fill times. So we contacted several volumetric feeder suppliers, and one of them wanted to conduct tests at their test center, so I sent them a variety of ingredients for testing."

This supplier, Schenck AccuRate, operates a full-service test center at its facility in Whitewater, Wis., and manufactures and supplies volumetric and gravimetric feeders, vibratory feeders, weighfeeders, controls, custom systems, and other bulk solids handling equipment to the food, chemical, pharmaceutical, plastics, and other industries.

The supplier conducted multiple tests to determine the ideal equipment and preliminary operating parameters for the ingredients and sent the results back to the company. "I then took the base bars to their test center, and we set up a belt conveyor and watched the feeders fill the ingredients into the base bar cavities," says Cessna. "This allowed us to see that the various ingredients have different trajectories when they discharge from a feeder and that they bounce differently when they hit the base bar, causing some of them to spill out. We found that the discharge height is critical to not having the pieces bounce out, so we adjusted the feeder's height and horizontal position for each ingredient, enabling each one to hit the target more accurately. We also determined the feeder run time and feedrate for each ingredient."

After successfully completing the tests, the company placed a purchase order in Fall 2009 for two volumetric screw feeders and four volumetric vi-

"We needed feeders that could reliably feed small batch sizes in short time intervals and handle a wide range of ingredients with disparate particle sizes and flow characteristics."

A vibratory feeder accurately dispenses an ingredient into a chocolate base bar's recessed cavity.

bratory feeders. Cessna says, "We selected these feeders not only because of their ability to precisely handle small batch sizes in short times, but also because of their ability to feed a number of ingredients with different densities and particle sizes."

The volumetric feeders

The two MECHATRON low-range Coni-Flex dual-drive screw feeders have a maximum throughput of 21 ft^3/h and are used to dispense ingredients with particle sizes larger than 5 millimeters, such as rainbow jimmies and rice crisps. Each feeder has a 1-cubic-foot-capacity hopper extension, a 0.75-inch-diameter helix with an end stub, and a 1.375-inch-diameter nozzle with bottom discharge. The feeder has two variable-frequency-drive, washdown-duty motors — one drives the helix and the other powers external agitation paddles that massage the feeder's FDA-approved flexible hopper to promote material flow to the helix.

"Because of the ingredients' large particle sizes, we had to oversize the feeder's nozzle to allow the ingredients to move freely through it during operation," says Tom Symoniak, Schenck AccuRate senior applications engineer. "A tight tolerance between the helix and nozzle wall would've stopped material flow and degraded the ingredients. And since we used an undersize helix in an oversize nozzle, we put an end stub on the helix and a triclamp fitting with end bushing on the bottom discharge nozzle to support and center the helix, ensuring that it maintains position during operation and doesn't ride up or down. Additionally, for cleanout ease, the triclamp fitting can be disassembled without tools, and a custom cleanout insert installed in the hopper bottom allows it to be completely emptied by just running the helix."

The four MECHATRON LS low-range Coni-Steel Vibro vibratory feeders have a maximum feedrate of 28 ft^3/h and are used to dispense ingredients such as graham cracker cookie pieces, white chocolate chips, chocolate cookie bits, and other free-flowing ingredients that can be easily damaged. The feeder has a 1-cubic-foot-capacity hopper extension and a 70-millimeter-wide feed tray that can be adjusted for height to accommodate ingredients with different particle sizes. An electromagnetic phase-angle vibratory drive with a 4-to-20-milliamp input vibrates the feed tray and controls the feedrate. A feedback sensor on the tray monitors the tray amplitude and sends a signal back to the drive to maintain the designated feedrate.

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All six feeders are constructed of food-grade Type 304 stainless steel, and each feeder is mounted on a structural steel stand. "A low-level indicator mounted on the side of each hopper signals the production line's control system to alert an operator when a hopper needs to be refilled," says Symoniak. "And a removable grate magnet on each hopper's top ensures food safety and allows easy access to the hopper's interior for cleaning. Additionally, since the interior of each feeder can be accessed from the nonprocess side, the feeder doesn't have to be removed from the production line for cleaning."

Feeding the ingredients

The company installed the feeders side-by-side in a straight line so that the servo-driven indexing belt conveyor runs directly below each feeder's discharge. A clear plastic guard between the belt conveyor and the attraction's visitor area allows visitors to see the ingredients being added to their candy bar.

During operation, a base bar is moved up to and parked at a photo eye that's installed on the conveyor's side and centered under the feeder's discharge. The photo eye signals the control system that the bar is in position and ready to be filled with the selected ingredient. The conveyor then moves the bar past the photo eye while the feeder dispenses the ingredient into the bar's cavity, which takes less than 5 seconds. After the bar moves past the photo eye, the conveyor stops for a brief moment before moving it to the next feeder. If the next feeder's ingredient is one that's not been selected, the conveyor moves the bar just as previously detailed, but the feeder doesn't dispense anything.

"We place a ribbon of an ingredient in the bar's bottom, then another ribbon, and finally another ribbon on top of that to provide an even displacement of the ingredients," says Cessna. "We keep the larger particles in the upstream feeders and the smaller particles in the downstream feeders, because the smaller particles fill down into the cavity and around the larger particles, which helps minimize the bar's profile."

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Creating a unique, positive experience

Since opening the HERSHEY'S Create Your Own Candy Bar attraction, reactions from visitors have been favorable and the company expects the attraction to be one of its most popular experiences. "The visitors are happy because they get to be a part of the production process and see authentic plant equipment making their very own candy bar," says Cessna. "We're pleased with the feeders' ability to hit the target without spillage. Visitors are

amazed that the ingredients aren't spilling out all over the place. The reliability of the equipment helped make this a successful project and a great attraction for years to come."

According to Cessna, the supplier has been and continues to be a responsive vendor for this project. "The support the supplier provided for past projects was one reason we selected their feeders. We continue to test new ingredients at their facility before we add them to the line because we change the ingredients seasonally and the densities and particle sizes are always changing." **PBE**

Note: Find more information on this topic in articles listed under "Feeders" in *Powder and Bulk Engineering*'s comprehensive Article Index in this issue and at *PBE*'s Web site, www.powderbulk.com, and in books available through the Web site in the *PBE* Bookstore. You can also purchase copies of past *PBE* articles at www.powderbulk.com.

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