Drumming out the drums

A company installs five bulk bag unloaders and five volumetric screw feeders to automate its portable-hopper loading operation.

A company that produces welding and cutting products for national and international markets was experiencing problems loading materials from drums into a large portable hopper. Handling the drums created ergonomic and safety issues for the operator, took a lot of time and labor, and caused storage and disposal problems. To solve these problems, the company worked with a dry solids processing equipment supplier to automate the portable-hopper loading operation.

The company produces various welding and cutting products at its facility in southeastern Pennsylvania. To make a certain welding product, an operator first loads various amounts of bauxite, sand, magnesite, fluorspar,

The five bulk bag unloaders and five volumetric screw feeders accurately feed material to a centrally located portable hopper.

manganese ore, and two additional minor ingredients into a large portable hopper, making a 1,400-pound batch. The operator then forktrucks the hopper to the beginning of the production line at the opposite end of the plant and discharges the hopper's material into a mixer. The mixer homogeneously blends the material before discharging it to the production line.

In the past, the five major ingredients were contained in 55-gallon drums, and the two minor ingredients in boxes. The portable hopper was positioned on a gain-in-weight load-cell scale in a scale area. To add a minor ingredient, the operator scooped the material from a box and hand-added it to the hopper, watching the hopper scale's readout to ensure hitting the target weight.

To add a major ingredient, the operator mounted a barrel dumper on the forktruck's forks and moved the drum to the hopper. The operator then got down from the forktruck, opened the drum, and climbed back onto the forktruck before activating the barrel

Handling the drums created ergonomic and safety issues because the operator had to get on and off the forktruck multiple times and manually position the drums in the barrel dumper.

An operator uses a forklift to lift the bag-lifting frame and empty bag from the unloader.

dumper, which dumped a majority of the material into the hopper. Monitoring the hopper scale's readout, the operator deactivated the barrel dumper when the material neared the target weight. The operator hand-added the remaining needed material to the hopper. Upon completion, the operator closed the drum and forktrucked it back to the storage area if it still contained material or to a disposal area if it was empty. The operator repeated this process for each major ingredient.

Problems with the drums

The company experienced several problems using the drums in the portable-hopper loading operation. Handling the drums created ergonomic and safety issues because the operator had to get on and off the forktruck multiple times and manually position the drums in the barrel dumper. Also, because the material in the drums was compacted and difficult to get out, the operator had to be careful to avoid back or other injuries when manually scooping the material from the drums. And because the average particle size of the various materials is about 50 percent at 325 mesh, dumping the drums and hand-adding the material into the hopper created fugitive dust in the scale area. For protection from the dust, the operator had to wear a respirator when making a batch.

Manually loading the materials into the hopper to make a batch sometimes took an operator more than an hour. And during this time, the production line was left unattended because the operator had to be in the scale area, which is located at the opposite end of the plant from the production line's beginning. In addition, drum storage and disposal created a problem because of space constraints for storing the full and empty drums and cost factors for disposing of the empty drums.

Because of these problems, the company decided to look for a way to automate the portable-hopper loading operation and receive material in bulk bags to eliminate the drums.

Looking to automate

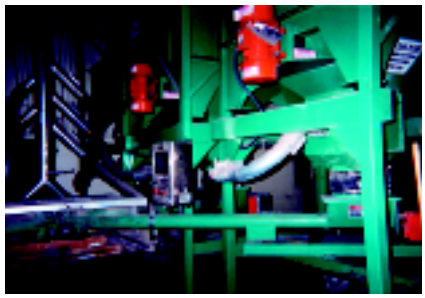
In spring 2002, the company hired a project engineer to help find a solution for the portable-hopper loading operation. The project engineer conducted an extensive Internet search for bulk solids handling equipment suppliers and found Metalfab, Vernon, N.J., a supplier of bulk bag unloaders, bin activators, volumetric screw and belt feeders, batch and continuous loss-in-weight feeders, continuous blenders, spin loaders, and other dry solids processing equipment. The project engineer contacted the supplier for more information.

The project engineer ordered five bulk bag unloaders, five bag-lifting frames for lifting and moving the bulk bags, and five volumetric screw feeders with 4-inch-diameter enclosed screws, which he helped the company install in the scale area.

Later that year, the supplier invited the project engineer to tour its facility and to see its equipment in operation. After the tour, the supplier had the company send material samples in bulk bags for testing, and the project engineer traveled back to the supplier's facility to witness the tests. For the tests, the supplier mounted a volumetric screw feeder beneath a bulk bag unloader and demonstrated the system's ability to accurately discharge and feed each of the materials from the bulk bags. Satisfied with the results, the project engineer ordered five BBU2-48V bulk bag unloaders, five bag-lifting frames for lifting and moving the bulk bags, and five DB2-4 volumetric screw feeders with 4-inch-diameter enclosed screws, which he helped the company install in the scale area.

The unloaders and screw feeders

Each bulk bag unloader is constructed of carbon steel and is about 15 feet tall to accommodate a feeder beneath it. A bag-support frame, located in the unloader's top within the main frame, receives a bag-lifting frame and supports



The scale's microprocessor controller (center, silver box), which is programmed with various batch formulas and target weights, controls the portable-hopper loading operation.

it and a bulk bag during operation. The supplier mounted a vibrator on each bag-support frame that vibrates the frame when a material needs to be discharged and automatically shuts down when material is no longer needed.

Each carbon-steel feeder screw's flighting has a standard 4-inch pitch and can accurately feed material at up to 175 ft^3/h. The screws have no hard plating because the company's material isn't very abrasive. Each feeder has an extended tube and screw, ranging from 4 to 9 feet long, and is designed to bulk- and dribble-feed the material directly into the centrally located portable hopper.

The company also worked with Rice Lake Weighing Systems, Rice Lake, Wis., a scale supplier, to install a new scale and control system for the portable-hopper loading operation. The scale supplier connected the scale's microprocessor controller to the hopper scale's electronic load cells and each bulk bag unloader's vibrator and feeder to automate the hopper-loading process.

Making a batch

In April 2003, the company began using the supplier's equipment to make batches. The materials arrive at the company's plant in standard bulk bags that are about 48 inches square by 60 inches tall and hold about 2,000 to 3,000 pounds, depending on a material's bulk density. The bags are stored in a warehouse.

To make a 1,400-pound batch, an operator maneuvers the forktruck's forks into a bag-lifting frame's two metal fork-receiving tubes, which are in the frame's top. The operator then lowers the bag-lifting frame over a bulk bag, gets off the forktruck, and manually places the bag's lift loops over the frame's adjustable position posts to secure the bag. The operator uses the forktruck to lift and move the bag to the bulk bag unloader and lowers the bag-lifting frame into the unloader's bag-support frame, which has a top crossbar to support the frame and bag.

The crossbar is set at a height that allows the bag's bottom to slide through a flat, flexible rubber skirt and sit snuggly in the unloader's inverted-pyramid-shaped bag-support base that goes from a 48-inch-square opening down to a 10-inch-diameter opening. The rubber skirt, which has a 30-inch-diameter hole in its center, follows the bag down and compresses against its sides to create a dust-tight seal, preventing fugitive dust. As the bag discharges material, the rubber seal follows the bag inward, returning to its original shape when the bag is empty. When the bag is removed, the rubber skirt becomes flat again.

After the bag is properly seated, the operator accesses the bag's bottom discharge spout through an access door in the unloader's tie box, which is located directly beneath the bag-support base at about shoulder level. The tie box's dust collection port is connected to a central dust collection system to prevent fugitive dust during material discharge. The operator then closes the access door and walks to the scale's microprocessor controller to activate the system.

The operator first calls up a batch's recipe via the controller, which is programmed with various batch formulas and preset target weights for each product the production line makes. The operator pushes a start button and the controller activates the first unloader's vibrator and feeder. As the vibrator vibrates the bag-support frame, material discharges from the bag into the screw feeder's inlet trough. The feeder discharges material in bulk to the portable hopper, and the controller monitors the hopper weight via the scale's load cells.

When the hopper weight nears the target weight, the controller slows the feeder's feedrate to dribble-feed the remaining material into the hopper. The controller shuts down the vibrator and feeder when the target weight is reached and activates the next unloader's vibrator and feeder. The controller repeats this process in sequence for the remaining major ingredients.

When a bulk bag is empty, the feeder's screw continues to run, so the operator pushes a hold button to stop the feeder and then changes the bulk bag. After the new bag is seated, the operator pushes a restart button, and the portable-hopper loading operation starts up where it left off.

After the major ingredients have filled into the hopper, the controller prompts the operator to add the minor ingredients. The operator then hand-adds the first minor ingredient directly into the hopper. When the controller detects the target weight, it prompts the operator to add the next minor ingredient.

Drumming up success

Since installing the new bulk bag unloaders and volumetric screw feeders, the company has improved the portable-hopper loading operation's ergonomics and safety. "The hopper loading operation isn't as labor-intensive anymore because the operator no longer has to manually move the drums or scoop material out of them," says Mark Dornbush, the company's quality assurance engineer. "And the nice thing about the new equipment is that a feeder's screw breaks up any material clumps that may have formed in the bags during transport and storage. That's very important since we're trying to get a homogenously blended granular final product. Additionally, the feeders' accuracy is well within our specification, feeding plus or minus only a small amount."

The company also eliminated fugitive dust in the scale area, so the operator no longer has to wear a respirator when making a batch. "In addition to the tie-box dust collection ports, we installed a dust collection port above the portable hopper so that when a feeder comes on, all the fugitive dust that's created there is sucked up," says Dornbush. "And to minimize waste, we recycle and reuse all the dust collected by the dust collector."

The new unloaders and feeders have also reduced the time that the operator is in the scale area preparing the batches. "The operator only has to leave the operation area, which is near the production line's beginning, to load a new bulk bag into an unloader or to call up a new recipe on the scale's controller," says Dornbush. "And by eliminating the drums and switching to bulk bags, we've increased our available storage space and reduced our empty-container disposal costs." **PBE**

Note: To find other articles on this topic, go to www.powderbulk.com, click on "Article Index," and look under the subject headings "Bagging and packaging," "Feeders," "Mechanical conveying," and "Weighing and batching," or see *Powder and Bulk Engineering*'s comprehensive "Index to Articles" in the December 2003 issue.

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