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DUST COLLECTION

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Automated batching for improved product quality and processing efficiency — Part II

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This two-part article explains how an automated batching system can overcome the inaccuracy, limited output, and other problems associated with manual batching operations. Part I (September) explained how automated gain-in-weight and loss-in-weight batching systems work, how they are applied, and what to consider when selecting a system for your application. Part II (October) concludes the article with information on selecting conveyors for an automated batching system, integrating the system with your plant equipment and controls, and promoting flow of difficult materials in the system; two automated batching system case histories are also included.

Some conveyor selection advice
Choosing conveyors for your automated batching system is a complex topic that could easily be the subject of an entire article. Sometimes, your batching system requirements will influence or even dictate which conveyors you choose for the system. In other cases, your existing conveyors or preference for a particular conveyor type will govern your choice. Here are a few rules of thumb for selecting conveyors for your automated batching system.

Generally, a mechanical conveyor is suitable for transporting both free- and non-free-flowing materials over relatively short distances and is appropriate for either a gain-in-weight or loss-in-weight batching system. However, in a loss-in-weight system, the load cells at each ingredient source, such as a bulk bag unloader, must account for the weight of the mechanical conveyor and the residual material it contains to weigh only the amount of material the unloader and conveyor have lost. To accomplish this, the unloader, the material it contains, and the conveyor must be weighed in their entirety, which requires supporting the conveyor from the unloader’s frame. However, the longer the mechanical conveyor, the more difficult it is to weigh the unloader and conveyor as one unit. This problem does not exist for a mechanical conveyor in a gain-in-weight system, because the conveyor’s discharge end can be suspended from a ceiling joist or other overhead structure over the batch vessel.

A pneumatic conveyor in a gain-in-weight system often requires a filter receiver above the process vessel and the headroom to accommodate it. In addition, the longer the pneumatic conveying line, the more in-flight material the system must compensate for.

Integrating the automated batching system with your plant equipment and controls
An automated batching system can be integrated with, or operated independently from, the plant’s bulk handling system or overall process.

Options for controlling your automated batching system include:
• A PLC dedicated to the batching system.
• A sequential batch controller, which is a programmable device that can store product recipes and control the batching system.
• An existing plantwide PLC integrated with a scale interface card that transmits weight data to the PLC.
Maintaining flow of difficult materials

Non-free-flowing materials that pack, cake, or bridge at various points in your automated gain-in-weight or loss-in-weight batching system can result in inaccurate ingredient measurements. To prevent this, your batching system must include equipment that promotes material flow throughout the system.

When your automated batching system handles materials unloaded from bulk bags, the system must maintain consistent flow from the bags. The way bulk bags are shipped and stored often packs the material, or worse, completely solidifies it, particularly in the case of certain fine powders, hygroscopic chemicals, and food products. To promote flow of packed materials, you can fit each bulk bag unloader in the system with pneumatically actuated plates that massage opposite bottom edges of the bag and push material into its outlet spout.

You can also equip each unloader with a device that maintains constant downward tension on the bulk bag spout as the bag empties and elongates, promoting complete bag discharge without requiring manual intervention.

Loosening materials that solidify in the bag can require a more extreme flow-promoting device: a bulk bag conditioner. The conditioner, which can be a stand-alone device, as shown in Figure A, or be integrated into the bulk bag unloader frame, uses hydraulic rams with contoured end plates to press opposite bag sides with high pressure at various bag heights to loosen the material and promote flow.

If your gain-in-weight batching system includes a weigh hopper, you must design the hopper to discharge 100 percent of the weighed batch with no residual material left in the hopper. To handle non-freeflowing materials, make sure the hopper incorporates appropriate wall angles and flow aids, such as vibration or air fluidization devices, to promote flow and full evacuation of the batch.

—D. Boger

Gain-in-weight system for isotopic chemicals production.
A chemical company installed an automated gain-in-weight batching system to produce a new isotopic chemical. Producing the chemical requires mixing five fine powder ingredients in batch weights ranging from less than 20 pounds (9 kilograms) to nearly 400 pounds (181 kilograms) with an accuracy of ±1.00 percent for each. Four of the ingredients are received in bulk bags, and the last, a minor ingredient, is received in 50-pound (23-kilogram) bags.

The gain-in-weight system includes four bulk bag unloaders for the four major ingredients, a manual bag-dump station for the minor ingredient, and five flexible screw conveyors lead-
ing from each unloader and the bag dump station to a weigh hopper mounted on load cells. Each conveyor is designed for the flow characteristics of the ingredient it handles. The weigh hopper, as shown in Figure 1, is equipped with a slide-gate valve that discharges to a Y diverter; one diverter leg discharges to a dry blender and one to a wet blender.

In operation, the gain-in-weight system’s controller activates the bulk bag unloaders to discharge a preset batch weight of two ingredients and the bag dump station to unload the minor ingredient; these ingredients are moved in sequence by the flexible screw conveyors at maximum feedrate to the weigh hopper. The load cells under the hopper transmit weight-gain information to the system’s controller, which starts and stops each conveyor and slows the feedrate to a dribble as the weight approaches the target weight, thus meeting the application’s strict accuracy requirements. The three ingredients are discharged from the weigh hopper through the slide-gate valve to the Y diverter, which diverts them to the dry blender for premixing. From there, the mixture discharges to the wet blender to be premixed with water. This process is repeated for the remaining two ingredients, which are discharged in sequence to the weigh hopper, then discharged through the slide-gate valve and routed by the Y diverter directly to the wet blender, where all the ingredients are mixed.

The gain-in-weight system meets the company’s strict accuracy requirements for the ingredient proportions in each batch of the isotopic chemical.

Loss-in-weight system for margarine production. A food products company wanted to switch from a manual batch-

Figure 1

Weigh hopper and flexible screw conveyors in chemical company’s gain-in-weight system

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ing operation to automated batching in its margarine production line to boost production and improve product quality. To make the margarine, salt and whey powder are premixed so they can be blended later with canola oil. In the manual operation, an operator dumped 33- and 44-pound (15- and 20-kilogram) bags of salt and whey powder into a premixer on an open processing floor. The manual process resulted in some dusting and bag spillage and required disposal of 100 empty bags a day. Occasionally, the ingredient quantities added to the premixer were not accurate.

To overcome these problems, the company installed an automated loss-in-weight batching system for the premix ingredients, which the plant now receives in 2,200-pound (1,000-kilogram) bulk bags. The system includes two bulk bag unloaders, one for salt and one for whey powder, as shown in Figure 2. Each unloader has an integral flexible screw conveyor and is mounted on load cells linked to the system controls and from there to the plantwide control system. Below each unloader is an 8-cubic-foot (0.22-cubic-meter) stainless steel hopper; a flexible screw conveyor runs from the hopper outlet to the premixer inlet. The entire system is enclosed. In operation, each loss-in-weight bulk bag unloader delivers preset batch weights of ingredient to the premixer.

In addition to increasing the plant’s margarine production by 50 percent, the loss-in-weight system’s automated controls minimize the risk of human error, improving the product quality. The completely enclosed system moves the salt and whey powder from bulk bag to premixer with no product contamination or fugitive dust.
The bulk bag unloader in this loss-in-weight batching system is mounted on load cells (within the yellow guards at the base of the unloader legs), allowing it to discharge precise amounts of powder to a screw conveyor that feeds three ribbon blenders.

Weighing your options

Thanks to the wide range of potential system configurations and available batching components, you can select an automated batching system that functions reliably in your application, improves product quality, and boosts product output while cutting production costs.

For best results, work closely with your batching system supplier. Choosing a supplier that offers both mechanical and pneumatic conveyors and a full range of other system components, including controls, will help ensure that your system is customized to handle your application. Witnessing tests of your batching system at the supplier’s facility is also an important part of the selection process, and tests on full-scale equipment will provide the most reliable proof that the system will work as designed with the accuracy you require.

For further reading

Find more information on automated batching in articles listed under “Weighing and batching” in Powder and Bulk Engineering’s comprehensive article index at www.powderbulk.com and in the December 2006 issue.

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