A combination of flexible screw and pneumatic conveying meets process requirements, with five flexible screw conveyors transporting ingredients to a weigh-batching system, and vacuum pneumatic conveying taking weighed and mixed dry ingredients to wet blending.

When Two Bulk Conveyors Are Better Than One

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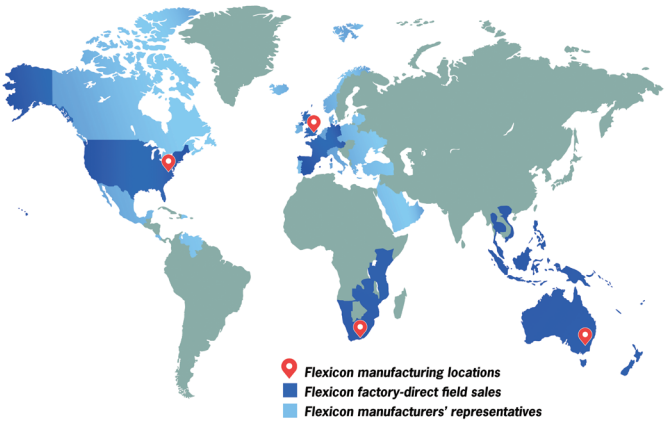

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When Two Bulk Conveyors Are Better Than One

Isotopic chemical characteristics require integration of mechanical and pneumatic conveyors for batching accuracy

QUAPAW, OK — To manufacture high-purity chemical and isotopic products, EaglePicher Technologies engineered a new process in which five bulk products are transferred, weighed with a high degree of accuracy, and conveyed to a mixing system.

The EaglePicher engineers knew the batch recipe and end result but were not biased toward any particular conveying technology or equipment design. After discussions with several different equipment vendors and a bidding process, EaglePicher ultimately chose a one-of-a-kind design from Flexicon Corporation that combined flexible screw conveyors and a weigh batching center to meet exacting measurement requirements at the beginning of the process, with vacuum pneumatic conveying downstream to transfer 100 percent of the weighed ingredients to final blending.

Five Ingredients, Two Routes

EaglePicher's proprietary process involves mixing five dried products, four received in bulk bags and one in 50-lb (23-kg) bags, plus water. The ingredients are fine powders, relatively free-flowing, dry, and dusty. Humidity in the system must be controlled to avoid absorption of room moisture by the dry feed.

Two of the ingredients go directly to a wet blender, and the other three ingredients are routed first to a dry blender for mixing and then on to the wet blender. Ingredient weights for the batch recipe vary from a minimum of less than 20 lb (9kg) to a maximum of nearly 400 lb (181kg) in each batch, and the process demands accuracies within +/- 1.00% of target over this broad range of ingredient weights, as well as for the water.

Design Combines Mechanical and Pneumatic Conveying for Accuracy

The process demanded bag unloading equipment and a weigh-batching system with powder conveying. Flexicon proposed a common gain-in-weight batching center using flexible screw conveyors to move th ingredients from the bag unloading hoppers, and pneumatic conveying to move the weighed ingredients to the proper destination. See figure 1 for an overall system schematic.

Bulk bags are unloaded with cantilevered I-beam bag unloaders equipped with electric hoists and trolleys, eliminating the need for a forklift. The bulk bag dischargers (Figure 2) are part of a sealed system that contains dust and promotes the flow and total evacuation of material.

Bulk bag unloaders utilize a proprietary bag-spout interface that creates a high-integrity sealed connection to contain dust and prevent contamination of the product and plant environment. A manual bag dump station with dust collection (center) protects workers and prevents plant contamination.

Flexible screw conveyors slow to dribble speed for pinpoint accuracy in measurement of ingredients to within 1% of recipe targets, and also isolate the powders from moisture in plant air.

An automated control system manages the entire process according to pre-programmed batch recipes.

The fifth, minor ingredient is manually unloaded into a bag dump station with dust collection. The operator dumps several bags at a time into the hopper, filling it with about a week's worth of the material.

The ingredients are transferred via flexible screw conveyors (Figure 3) into the weigh batch system. Each of the five screw conveyors is designed specifically for the powder being moved, with different sizes, materials of construction, and screw designs based on each material's bulk density and flow properties. Flexible screw conveyors are an ideal choice for this type of application, with each material-dedicated conveyor providing high accuracy and reliability with low maintenance.

The single, common gain-in-weight batching system (Figure 4) measures ingredients in sequence as they flow into the central weigh hopper. Load cells transmit weight gain information to a controller that starts and stops the conveyors, slowing to a dribble feed rate as the weight approaches the target in order to meet the high accuracy requirements. A slide gate valve at the bottom of the weigh hopper discharges the ingredient.

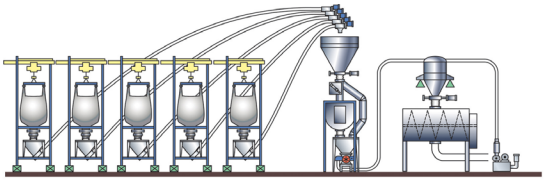
Since there are two different destinations for the weighed feed streams, a specially designed wye diverter valve sends each ingredient to the proper place, either the dry blender or the wet blender. The first two ingredients bypass the dry blender located just below the weigh batching system and drop through a rotary airlock valve into the vacuum pneumatic conveying system that takes them to the wet blender. There they are pre-mixed with water and given time to blend. The other three ingredients drop through the diverter valve directly into the dry blender, where they are mixed for 30 minutes. The blended mixture is then discharged from the bottom of the dry mixer through the same rotary airlock valve and into the same pneumatic conveying system for transfer into the wet blender.

The pneumatic conveying system was selected for its ability to handle the diverse range of powders with differing characteristics and because the system will evacuate itself of the material it conveys. Since the pneumatic conveying system will fully evacuate the vessel being discharged, as well as the conveying line itself, cross-contamination is minimized in this multi-ingredient system. Complete transfer of the material also ensures that both the individual and consolidated batch ingredients reach their destinations accurately by weight.

As each of the dry ingredients exits the pneumatic conveyor it is collected in a filter receiver equipped with reverse-pulse jet filter cleaning to dislodge accumulated dust from filter surfaces, assuring complete separation of the material from the vacuum air stream (Figure 5). The filter receiver hopper utilizes a load cell weigh module to confirm complete batch transfer. Another rotary airlock valve takes the powder directly into the wet blender below. A 20-hp (15kw) positive displacement vacuum pump located downstream of the filter receiver provides sufficient airflow to transfer all the materials.

Flexicon engineers were on site during startup for operator training. According to Loren Harding, EaglePicher's Manager of Operations, the integrated conveying package meets all process requirements and prevents contamination of its product and plant environment.

A filter-receiver with reverse-pulse filter cleaning continuously and efficiently separates the powder from the vacuum pneumatic system, dropping process feed into the wet mixer.



Five flexible screw conveyors transport powders from a bag dump station and four bulk bag dischargers to a gain-in-weight hopper mounted on load cells. Three of the ingredients are weigh batched, gravity discharged from the hopper into a dry mixer, and metered into a pneumatic conveying line that terminates at a filter receiver which discharges into a wet blender. The other two ingredients are weigh batched in the same manner, but they bypass the dry blending stage, and instead are metered directly into the pneumatic conveyor line that terminates at the filter receiver discharging into the wet blender, where all five ingredients are combined.

EaglePicher's ultimate choice of Flexicon was based on several important advantages. Harding said, "Flexicon had the weighing and batching experience to supply a unique integrated turnkey system, including PLC-based controls, with guaranteed accuracies. Furthermore, Flexicon's bulk bag discharger with patented bag-spout interface, was the best we encountered for maintaining a sealed system during unloading. Finally, and perhaps most importantly, Flexicon was the only company to propose a vacuum pneumatic system combined with mechanical conveying, the most advantageous solution for our requirements."

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