BEST COMPONENTS & BETTER SYSTEMS

THE RECIPE FOR PERFECT FOOD

coperion K-TRON

Application Example

Efficient Batching and Transfer of Food Ingredients to Mixers: Majors, Minors and Micros

Introduction

The manufacture of any blended food product typically involves the intermediate process steps of transfer and weighing or "batching" of individual ingredients based upon their weight percentage in a blend. Depending on this percentage, materials are usually categorized as majors, minors and micros. In many cases, the transfer and weighing of these majors, minors, and micros to the blending step can be a manual and labor intensive process. In an effort to improve process efficiency and product quality, the complete batching process can be automated. This includes the automated transfer of the raw ingredients to the batching system and the use of Gain-in-Weight (GIW) or Loss-in-Weight (LIW) batch devices to accurately and efficiently deliver the individual raw ingredients to the process. By utilizing automated transfer conveying methods for the raw ingredients using either vacuum or pressure, and also highly accurate means of batching, the manufacturer can realize lower overall manufacturing costs, inclusive of lower time required for manufacture as well as more savings on individual ingredients.

Ingredient Transfer: What Method is Best?

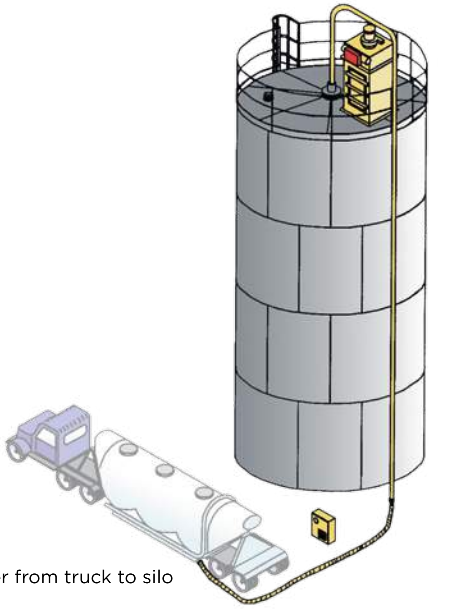
The transfer of ingredients is dependent upon a wide variety of process parameters, including material characteristics, distance to be transferred, required rate of transfer, and the type of container in which the ingredient is originally received. For example, majors such as flour, sugar and salt are often received by truck or railcar and then stored in silos prior to usage. Pressure Differential (PD) trucks and railcars use positive pressure to unload material, whereas other types of delivery to the batching step of process can often be done by either positive pressure or negative pressure pneumatic conveying.

PD Transfer

Upon the arrival of the PD truck at the plant, a flexible hose is connected from a pressure blower to the PD truck and another from the PD truck to the conveying line. The system operator selects the desired destination (for example, silo 1 for starch or silo 2/3 for flour on the truck unload control panel.)

When the system is started, the blower pressurizes the PD truck and conveys material via positive pressure from the truck through the conveying line and directly into the silo. Many times, an inline magnet installed in the conveying line to remove any metal particles which may be present in the conveyed material. When the high level sensor in the silo is activated, the operator closes the material flow gate on the truck and allows the system to purge the conveying line before finally stopping the operation.

Railcar transfer to and from silos



PD transfer from truck to silo

Pneumatic Transfer: Vacuum or Pressure?

As shown in the process flow diagram on page 2, other possible sources of ingredient delivery include bulk bags or super sacks, boxes, sacks and drums.

In all of the ingredient transfer steps, pneumatic conveying systems can be used to transfer these ingredients. These systems can utilize either vacuum or pressure dilute phase conveying.

Pressure conveying systems are typically used to transport product over long distances and at high throughputs. Applications which involve pressure conveying often include loading and unloading of large volume vessels such as silos, cyclones, railcars, trucks, and bulk bags.

Conversely, vacuum systems are often used for lower volumes and shorter distances. One of the advantages of vacuum systems is the inward suction created by the vacuum blower and reduction of any outward leakage of dust. This is one of the reasons why vacuum systems are often used in higher sanitary or dust containment applications. Another advantage of vacuum systems is the simple design for multiple pickup points. It should be noted, however, that the distances and throughputs possible with a vacuum system are limited due to the finite level of vacuum that can be generated. Often a combination of pressure and vacuum conveying designs are used for a system, as shown in the process flow diagrams, taking full advantage of the process and efficiencies of each technology.

Efficient Batching and Transfer of Food Ingredients to Mixers

Batch Weighing Principles

After transfer from the material source, the ingredients are usually delivered to the batching station. This station can include volumetric metering devices, such as a screw feeders or valves, which deliver the product to a hopper on load cells. This method is called Gain-in-Weight (GIW) batching. Alternatively, the station can include gravimetric feeding devices, such as screw or vibratory feeders, mounted on load cells or scales (see photo on page 3), which deliver the product to the process by means of Loss-in-Weight (LIW) feeding. As outlined below, in some cases where small amounts of micro ingredients are required for a total overall batch, both methods are employed: LIW feeders for the micros and minors, and GIW batchers for the major ingredients.

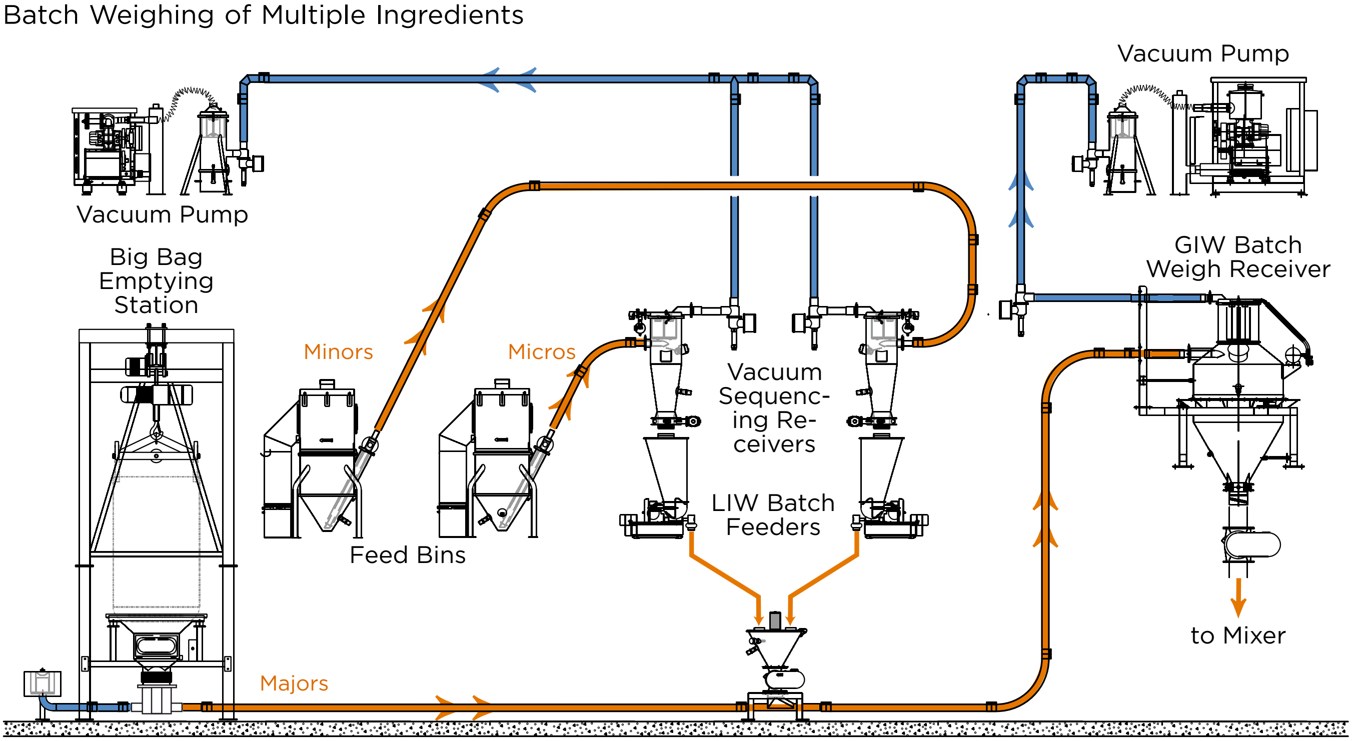
Gain-in-Weight Batching Principle

In GIW batching volumetric metering devices sequentially feed multiple ingredients into a collection hopper mounted on load cells. Each feeder delivers approximately 90% of the ingredient weight at high speed, slowing down towards the end of the cycle to deliver the last 10% at a reduced rate to ensure higher accuracy. The GIW controller monitors the weight of each ingredient and signals each volumetric feeder to start, increase or reduce speed, or stop accordingly. Once all the ingredients have been delivered, the batch is complete and the mixture is discharged into the process below. The photo on page 3 illustrates this type of batching station. It should be noted that this type of batching method is sequential for each ingredient, and therefore generally results in a longer overall batching time than with LIW batching (outlined below) if the number of ingredients is high.

Loss-In-Weight Batching Principle

LIW batching is used when the accuracy of individual ingredient weights in the completed batch is critical or when the batch cycle times need to be very short. Gravimetric feeders operating in batch mode simultaneously feed multiple ingredients into a collection hopper. Adjustment of the delivery speed (on/off, fast/slow) lies with the LIW feeder controls and the smaller weighing systems deliver highly accurate batches for each ingredient. Once all the ingredients have been delivered, the batch is complete and the mixture is delivered to the process below. Since all ingredients are being delivered at the same time, the overall batch time as well as further processing times downstream are greatly reduced. This method of batching is often used for micros, (such as trace elements and probiotics) due to the highly accurate requirement of their weight in the mix as well as their ingredient cost. In some cases the LIW feeder for the probiotic material can even be located within a protected enclosure or glove box, in order to ensure no contamination from the environment and a completely contained delivery of the ingredient to the process below.

Batch Weighing of Multiple Ingredients



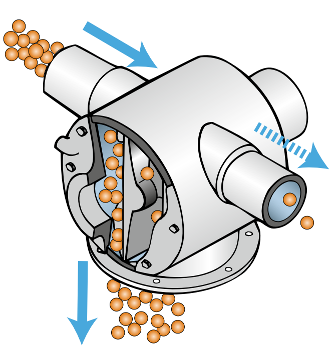
The main ingredient is fed directly from the big bag to the batch weigh receiver while minor igredients are added via loss-in-weight feeders for higher accuracy.

Multi Destination Majors Batching

When major ingredient batching requires a single ingredient to be delivered to multiple stations (see process diagram on page 4) or multiple ingredients delivered to a single destination, scale hoppers with specialty Aeropass™ valves mounted above the scale hopper can be used. After the fluidized material is discharged from a source such as a silo or bulk bag, it will typically drop through a Aerolock™ rotary valve, through a sifter (if required), and is then metered into the conveying line by another Aerolock rotary valve. Once in the convey line, it is then transported to the Aeropass valve, located above a scale hopper.

Aeropass Principle of Operation

The Aeropass valve operates on a diverter type principle and is ideal for diverting material directly into a hopper from a conveying line. Due to the valve's low-clearance height, it is ideal when requiring inline diverters in tight spaces. As shown in the figure below, the valve includes an internal wafer type device which allows for the discharge of material into the hopper below when activated in the correct discharge position. When the scale hopper below indicates the batch is complete based on the weight signal, the Aeropass valve can be immediately shut. This allows for the transfer of the excess material in the conveying line either to the next process or scale hopper, or back into the original source. This closed loop design results in a more efficient method of product transfer with higher product yields.



Aeropass valve

Batch Weighing with Scale Hoppers

Scale hoppers are receiving hoppers suspended on load cells for ingredient batch weighing (see photo below and diagram on p. 4). The material resides in the scale hopper until the precise weight and/or combination of materials is achieved. With the scale weighing system, weigh accuracies of +/- 0.5% of the full scale capacity can be expected. Once the desired weight has been achieved, the mixer then calls for material, a butterfly valve opens and the material in the scale hopper is discharged.

Options in Cleaning and Construction

Depending upon the ingredients to be batched and frequency of batching, a variety of design executions can be provided for the equipment to reduce the overall cleaning or changeover steps. Stainless steel is generally used for the contact components, but sometimes FDA approved epoxys can also be used for large volume scale hoppers or silos in order to reduce overall equipment costs. Conveying receivers can be designed with retractable spray balls for wash-in-place cleaning to ensure quick changeover and minimal contamination between material runs.

In cases where minimal product contamination is desired, such as delivery of isolated minors like probiotics, a specialized glove box design bag dump station can be provided. This ensures protection of the product from the outside environment.

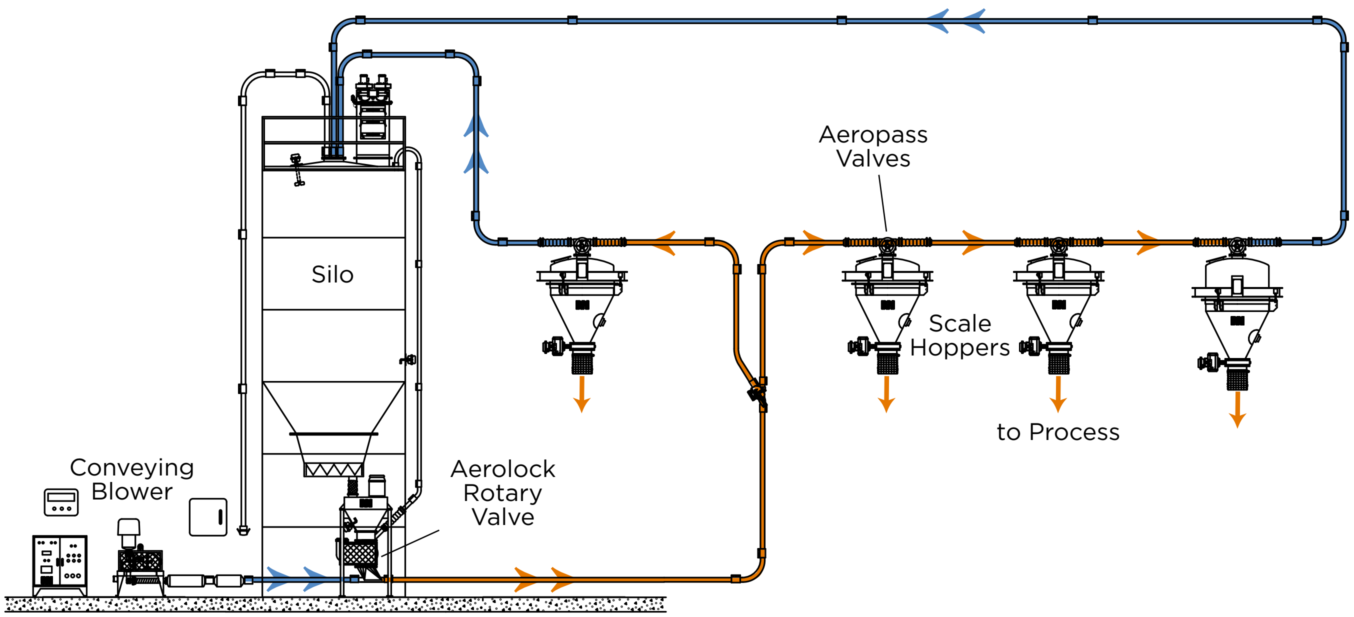
Scale hopper with Aeropass valve at top

Gain-in-weight batching station for a bakery installation in Indonesia.

Special glove box bag dump station

Efficient Batching and Transfer of Food Ingredients to Mixers

Scaling System for Multi Destination Batching



The bulk material is conveyed from the silo to a group of scale hoppers fitted with Aeropass valves.

When designing for a batching system, it is important to discuss all aspects of the design requirements, including the expected changeover and cleaning times, as these options can greatly affect the overall system cost.

Conclusion

Properly weighing and accurately delivering the ingredients without manual intervention can result in a number of process advantages, including fewer mistakes, better accuracy, lower bulk costs, improved product quality and savings in manufacturing costs. In addition, utilizing devices and systems which involve highly accurate weighing and metering of precious and expensive ingredients such as probiotics and vitamins can result in lower overall ingredient costs. The highly experienced personnel of the K-Tron Process Group can provide a wide variety of design and layout options in both ingredient transfer and delivery to help manufacturers to not only lower process costs but also to improve efficiency and product quality.

Coperion K-Tron Advantages

- The Coperion K-Tron Systems Group can supply integrated systems of Coperion K-Tron and ancillary products, with one source management and integrated controls
- Each solution is custom developed, drawing from Coperion K-Tron's extensive experience in providing material handling solutions
- All system receivers and components are designed with ease of maintenance and accessibility in mind
- Additional design options are available for P-Series pneumatic receivers for specialty sanitary applications
- Coperion K-Tron's Aerolock rotary valves and Aeropass valves are available in a variety of sizes and design options and meet CE and ATEX 3D classifications
- Coperion K-Tron Weigh Scale Hoppers and Batch Weigh Receivers are designed to provide batch weigh accuracies of ± 0.5% of the full scale capacity

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