



Application Example

High Accuracy Batching of Dry Ingredients for Wet Pet Food Applications

Background

Global wet pet food sales have seen a recent increase in growth due to an increased trend in cat and small dog ownership by millennials, gen-Z-ers and baby boomers. For example, smaller dogs can be fed more affordably with wet food than large dogs. In addition, cat ownership has risen globally, with significantly increased ownership in the Asian and Pan-Pacific markets. The added pet food trends of humanization of pet food (including the use of plant proteins), grain free, and customized premium ingredient recipes all present additional challenges for wet and dry pet food producers.

The accurate and automated addition of dry ingredients including majors, minors and micros to the wet pet food process is critical to maintaining low overall cost of high value ingredients, improved product quality, and overall process efficiency. In addition, automated

material handling methods such as pneumatic transfer and automated dispensing eliminate typically manual steps and greatly improve overall pet food product safety. Coperion K-Tron's extensive line of products specific to the pet food industry, as well as its process expertise based on numerous installations, all ensure the optimal in process design and product quality. This application sheet will focus on the various methods available for automated transfer and batch weighing direct to the wet pet food production process.

(For additional information on the extrusion process for dry pet food see our Application Example A-800303).

Pet Food Production

Dry ingredient addition to the wet and dry pet food process typically occurs at the beginning stages, prior to the mixing and grinding steps. Majors, minors and micros can be



introduced from a variety of sources, including boxes or drums, bag break stations or bulk bag/super sack unloaders. Upon discharge from these methods they are typically conveyed over to a high accuracy batching method, either via loss-in-weight or gain-in-weight for accurate ingredient proportioning as shown in Figure 1. The correct and automated proportioning of the ingredi-

ents ensures that the product quality is maintained, while adding extra flexibility to the line for various recipes. From this batching method, the proportioned ingredients are then pneumatically transferred to a receiver with discharge directly to the mixer or mixers below. After mixing and grinding the product is usually cooked with steam (also known as the "kill step") to ensure product safety.

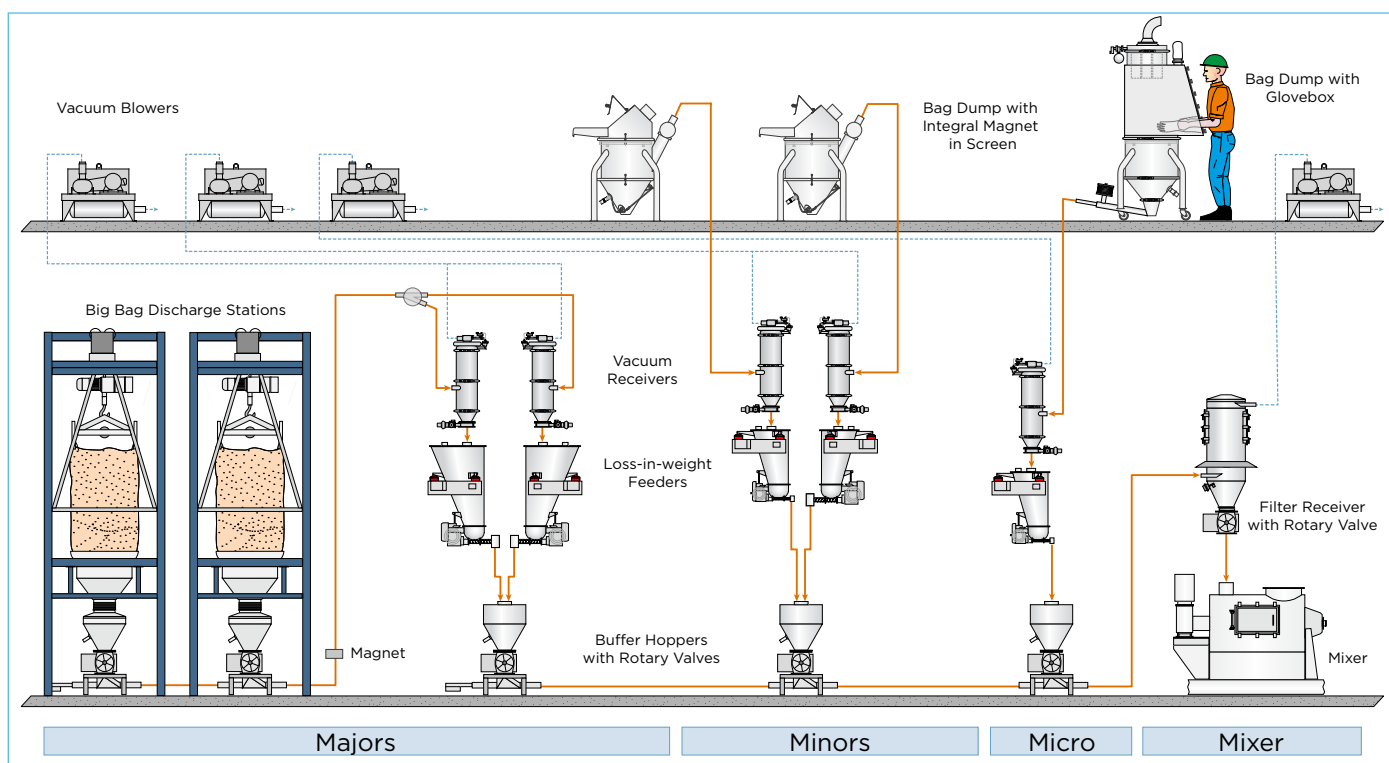


Fig. 1: Sample process diagram for wet pet food production

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For wet pet food, subsequent to the cooking step, the sauce or jelly is added to the product, in addition to any additional ingredients such as vegetables. Final steps for wet pet food include canning, sterilization and packing. It is important to note that production of the gravy or sauce can also include the dry ingredient dispensing. Precise and automated metering of these ingredients is often also done by the transfer and batching methods outlined below.

Ingredient Transfer: What Method is Best?

The arrival and transfer of major, minor and micro ingredients to a pet food plant can include a number of different types of conveying systems. The mode of 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. PLC systems featuring recipe control for multiple ingredients can easily be integrated into this transfer system, in order to allow maximum flexibility for the system.

Selecting the Right Conveying Technology

Depending upon the volumes required, possible sources of ingredient delivery include boxes, sacks, bulk bags or super sacks. Pneumatic conveying systems can be used to transfer these ingredients in all steps of the process, utilizing either positive or negative pressure dilute phase conveying. Positive pressure conveying systems are typically used to transport bulk materials over long distances and at high throughputs. Applications which involve pressure conveying often include loading and unloading of large volume vessels such as bulk bags. Conversely, vacuum (negative



Fig. 2: Hygienic Side Entry Receiver

pressure) 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. A continuous vacuum system utilizes a continuous vacuum source and a filter receiver (Figure 2) with a rotary valve below to maintain vacuum within the receiver and constant output at the same time.

In a vacuum sequencing system the vacuum receiver is fitted with a discharge valve. When closed, the system transfers the material until a preset time or fill level is reached. Once the re-

ceiver is full, or the time elapsed, the vacuum is broken, and the discharge valve on the receiver opens and discharges the material. In the case of the Coperion K-Tron sequencing receivers, a pulse of air is blown through the filters within the receiver during this discharge, in order to avoid material build-up on the filter media and optimize conveying efficiency. The process is sequenced and repeated until the specified amount is delivered to the process below, such as the mixers shown in Figure 1.

It is important to note that vacuum sequencing systems typically allow for more versatility in product pickup and destinations, and also can often utilize a single vacuum source for several receivers, depending upon the demands of the downstream process.

For additional information on pet food conveying methods, see our Technical Paper T-900011 'What Is the Best Pneumatic Transfer Method for My Pet Food Process'.



Fig. 3: Scale Hopper

Batching Systems

After transfer from the material source, the ingredients are usually delivered to the batching station. This station can include volumetric metering devices, such as 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, 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 can be combined: LIW feeders for the micros and minors, and GIW batchers for the major ingredients.

Gain-in-Weight Batching

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. 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.

GIW Batch Weighing with Scale Hoppers

When major ingredient batching requires a single ingredient to be delivered to multiple stations 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 Coperion K-Tron rotary valve, through a sifter (if required), and is then metered into the conveying line by another Coperion K-Tron rotary valve. Once in the convey line, it is then transported to the Aeropass valve, located above a scale hopper, as shown in Figure 3. Scale hoppers are receiving hoppers suspended on load cells for ingredient batch weighing. 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 $\pm 0.5\%$ 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.

Loss-in-Weight Batching

LIW batching utilizing Coperion K-Tron high accuracy screw feeders such as those shown in Figure 4 provides a significant accuracy and process time advantage over traditional GIW batch techniques. 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 high value ingredients due to the highly accurate requirement of their weight in the mix as well as their ingredient cost.



Fig. 4: Gain-in-weight batching system in a food application

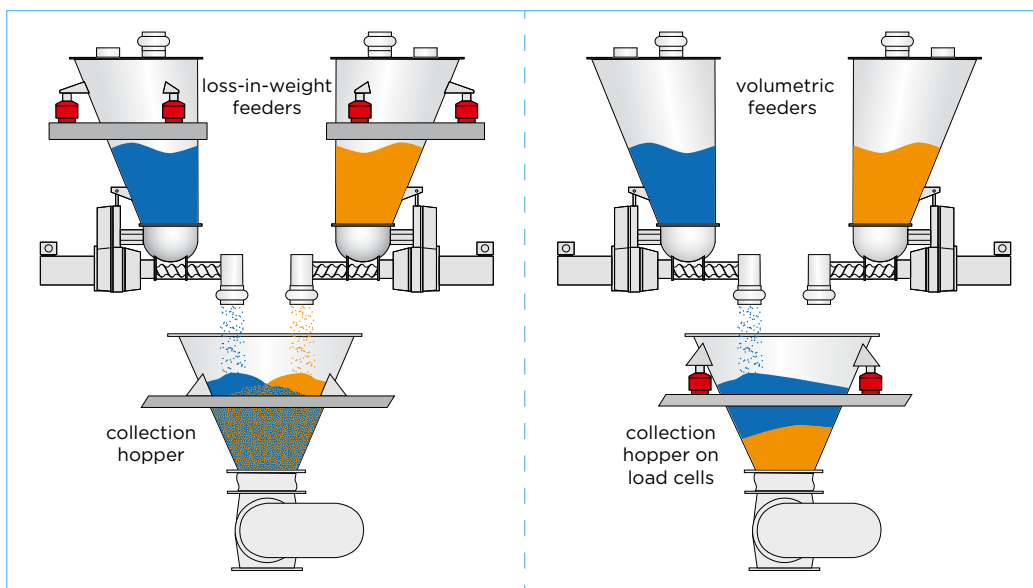


Fig. 5: Loss-in-Weight Batching (left) vs. Gain-in-Weight Batching (right)

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As shown in Figure 5, in the LIW batch process the actual amount of product which leaves the feeder is determined by measuring the difference, or loss in weight. As with GIW batching, the first 90% of the batch weight (as determined by the pre-programmed recipe) is fed at a fast rate by the feed screws. The last 10% is fed in a slower “dribble” mode to ensure an accurate batch weight, reaching accuracies of $\pm 0.1\%$ of the desired setpoint. The Coperion K-Tron Control Module (KCM) uses the LIW Batcher control software to regulate the delivery speed (on/off, fast/slow) and also offers the possibility to quickly change batch setpoints based on the packaging requirements for each product.

Why LIW Feeders Are Ideal for Batching

Coperion K-Tron's gravimetric feeders feature digital load cells to constantly measure the weight of the ingredient being delivered to the process below. LIW feeding affords broad material handling capability and thus excels in feeding a wide range of materials from low to high rates.

All Coperion K-Tron LIW feeders use state-of-the-art Smart Force Transducer (SFT) digital load cell technology. This technology has 1 part in 8,000,000 resolution in 20 ms and includes vibration filtration and temperature compensation which allow the feeder to be controlled on a second to second basis with unprecedented performance levels.

The Coperion K-Tron Advantage

- Complete systems design integration of the wet or dry pet food manufacturing process for one source supply.
- Global systems engineering group with extensive application experience for the entire wet pet food processing line ensures optimal design with an emphasis on product safety, quick product changeover, and increased efficiency.
- The Coperion K-Tron line of feeders provides for the highest degree of accuracy in ingredient and product delivery in order to optimize ingredient cost savings.
- Integrated control systems featuring Coperion K-Tron SmartConnex and customized PLC control allow for a variety of programming options including ingredient control and recipe management.
- Extensive material handling knowledge in a wide variety of ingredients by the engineers at Coperion and Coperion K-Tron ensures the most efficient means of product transfer.
- Superior global service network to ensure 24-7 support and coverage of your complete pet food processing line.
- The Coperion K-Tron Control Module (KCM) provides integrated control of motor, load cell and drive functions for both batch weighing and continuous feeding applications.
- Integration with the Series 4 controller for automated refill by Coperion K-Tron sanitary pneumatic receivers optimizes the system operation.
- The Coperion K-Tron line of pet food processing equipment is designed for easy cleaning and access, with FDA approved materials of construction.
- Coperion K-Tron is able to provide a wide variety of screw and agitator designs, in order to give best results for a wide range of ingredients, including the gentle handling required for wet and dry pet food ingredients.
- Whether batching or continuous feeding, the Coperion K-Tron Systems Group can supply integrated systems including ancillary products, with one source management.



Fig. 6: T60 twin screw loss-in-weight feeder

For additional information and application information on extrusion, feeding and material handling for all pet food and pet treat processes, see www.coperion.com/food.

