

Application Example

Accurate Transfer, Feeding and Batch Weighing of Probiotics into Blending and Packaging Operations

Background

According to both the Food and Agricultural Organization (FAO) as well as the World Health Organization (WHO), probiotics are defined as “live microorganisms” which, when administered in adequate amounts, confer a health benefit on the host”. These food supplements help to improve the intestinal microbial balance within any host, whether it be pets, livestock or human beings. Global use of probiotics has steadily increased over the last 10 years, mainly in dairy products such as yogurts and yogurt beverages. However, even more recently, the introduction of probiotics in a powdered microencapsulated form for nondairy foods such as infant formulas, health food bars, breakfast cereals, snack foods, dry pet foods, and even chocolate has become commonplace in the food and pet food marketplaces. This growing trend in the use of probiotics can be attributed to the increased media exposure emphasizing that intestinal balance is critical to obesity management, cancer prevention, as well as improved overall immune system health.

Introduction of Probiotics to the Packaged Product

Due to the delicate nature of the probiotic organism, the introduction of probiotics to the food processing or packaging stages requires special attention. The probiotic must be treated carefully during all stages of food processing to ensure that the probiotic viability is not affected and the overall efficacy is maintained. Coperion K-Tron loss-in-weight (LIW) feeders and sanitary vacuum conveying systems are used in the highly accurate introduction of probiotic powders to continuous mixers, as well as for the contained transfer and LIW batching to the final packaging container.

In the case of batch weighing of the probiotic to bulk packaging, such as a supersack or flexible container, the LIW batch principle is often employed. As explained in the following section, the K-Tron LIW batching system utilizes highly accurate Coperion K-Tron load cells to ensure an exact and controlled amount of product is introduced to the process or package below. In addition, depending upon the room and space requirements, a specialized Coperion K-Tron bag dump station with integrated glovebox may be used to introduce the probiotics either directly to the feeder or into a pneumatic conveying system to transfer the product to a receiver mounted directly above the feeder hopper. In both cases, the system is completely contained, in order to avoid any outside contaminants interacting with the probiotic powder.

Batch Weighing Principles

When delivering a powdered ingredient to a process, there are two modes of batch weighing which can be utilized. In Gain-in-Weight (GIW) batching, the system uses volumetric metering devices, such as a screw feeders or valves, to deliver the product to a collection hopper mounted on load cells. Only one component can be added at a time, resulting in a longer overall batch time.

Alternatively, the batching system may use gravimetric feeding devices, such as screw feeders, mounted on a weighing system to deliver the product to a collection hopper or even directly to the process by means of LIW Batching.

Loss-in-Weight Batching

In the case of probiotics addition, LIW batching is used because the accuracy of individual ingredient weights in the completed batch is critical and



Probiotics are widely available as dietary supplements but also often incorporated in prepared foods.



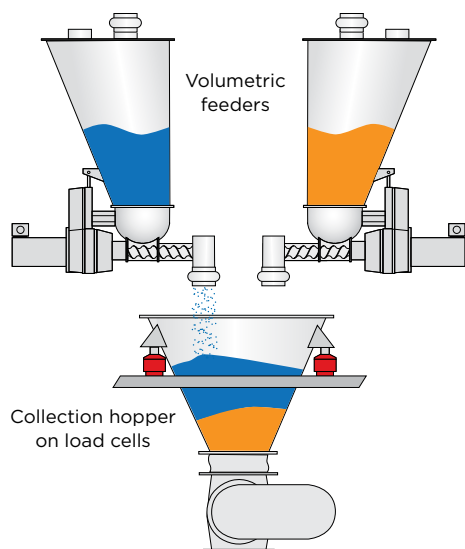
Contained Probiotics bag dump station, outfitted with a volumetric feeder for Gain-in-Weight Batching

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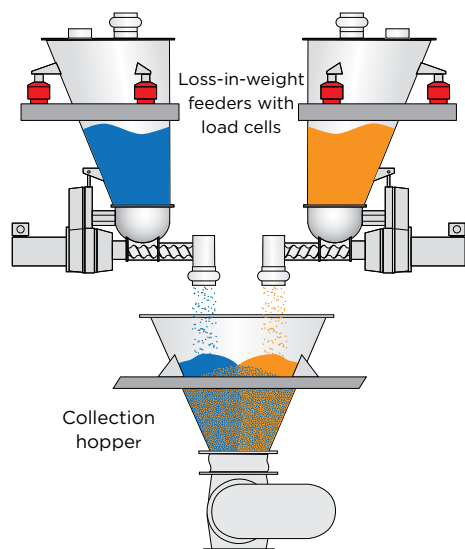
the percentage of the probiotic to the overall size of the final batch is very small. For example, if one were to use GIW batching, the complete bulk bag or FIBC containing the major ingredients must be mounted on load cells with a high enough capacity to weigh the total weight of the bulk container. A weighing system of this size would not be able to accurately detect

the typically small amount of the probiotic which needs to be added to such a large batch. Therefore, the use of a smaller LIW feeder to accurately weigh and deliver a minute amount to the container is more appropriate.

LIW batching also offers the advantage of a much shorter batch time when batching multiple ingredients. Since each



Gain-in-Weight Batch



Loss-in-Weight Batch



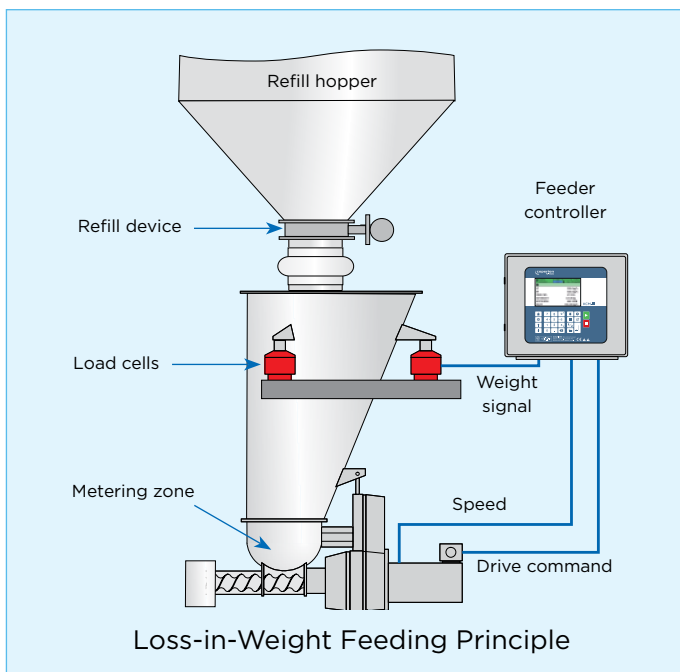
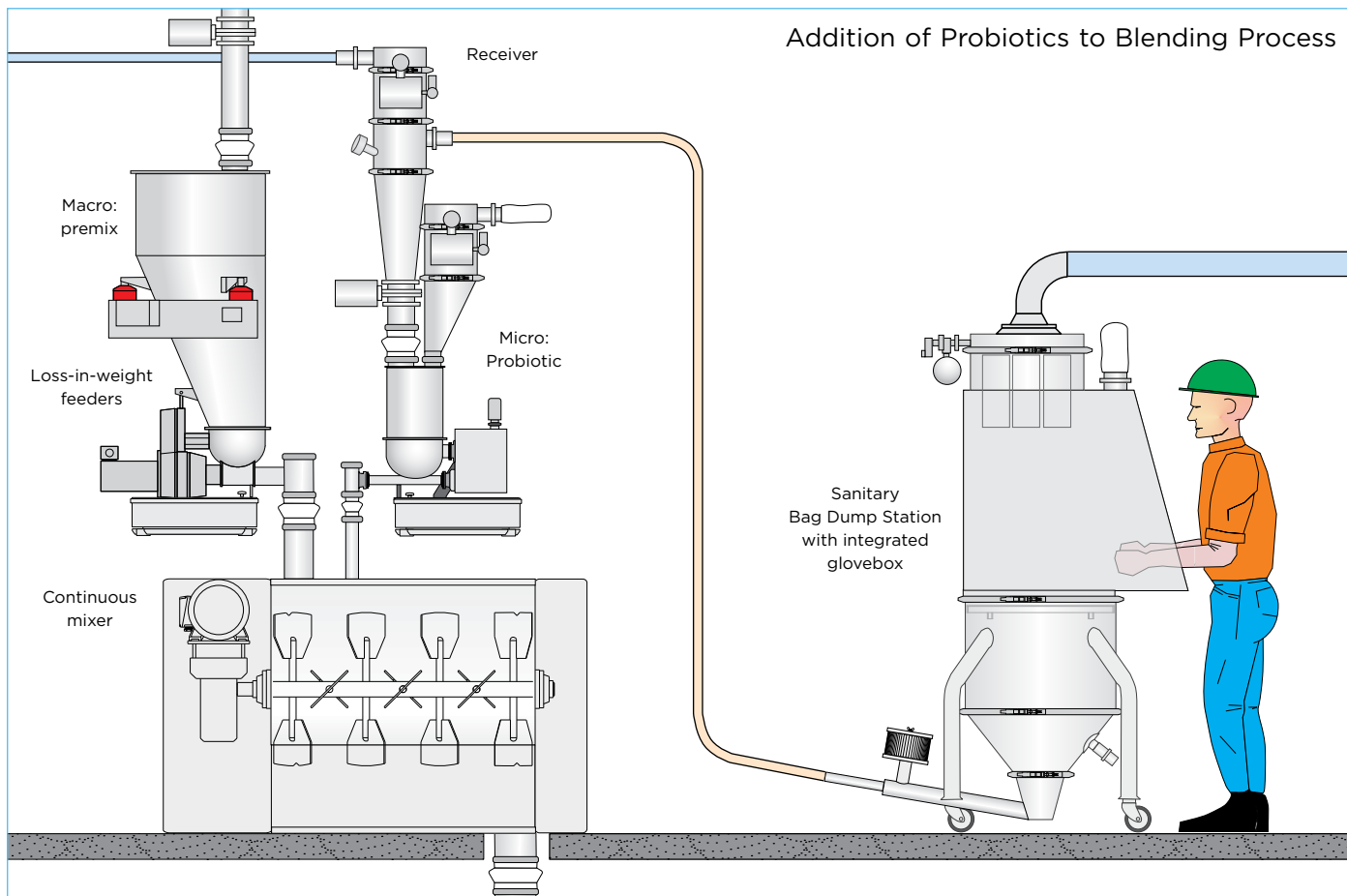
Sanitary bag dump station with integrated glovebox for conveying Probiotics directly to a P-Series vacuum receiver

LIW feeder has its own weighing system, several gravimetric feeders operating in batch mode can simultaneously feed multiple ingredients into a collection hopper.

A batch cycle is comprised of two phases. During the first phase, 90% of the batch weight (as determined by the preprogrammed recipe) is delivered as quickly as possible. In the second phase the last 10% is fed in a slower "dribble" mode to ensure an accurate batch weight equal to $\pm 0.1\%$ of desired setpoint.

Adjustment of the delivery speed (on/off, fast/slow) as well as the ability to quickly change batch setpoints based upon the packaging requirements is set using the Coperion K-Tron LIW batcher controls.

LIW batching is often used for micros (such as vitamins and probiotics), where a highly accurate result is beneficial both to ensure the required product formulation and to avoid unnecessary waste, since these supplements are often very costly.



Feeding in a Continuous Mixing Process

In some processes the probiotics can be added during the mixing stage. LIW feeders are generally used here to accurately and gently deliver the probiotics into the mixer. In addition, Coperion K-Tron sanitary pneumatic receivers are used to refill these feeders, which is critical for maintaining the accurate and consistent delivery of the probiotic material to the process.

Continuous LIW Feeding

Coperion K-Tron's gravimetric feeders feature state-of-the-art SFT digital load cells to constantly measure the weight of the ingredient being deliv-

ered 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. In operation, the entire feeder, hopper, and material are continuously weighed, and the feeder's discharge rate (the rate at which the feeding system is losing weight) is precisely controlled to match the desired feed rate. Gravimetric feeders have low fluctuations in feed rate because variations in the filling degree of the screws and in the bulk density of the feed material are compensated by modulation of the screw speed. With this technology, a constant mass flow is ensured, thus providing consistent product output.

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Designing for Probiotic Handling

Whether designing for batching or continuous feeding processes, the probiotics system is carefully engineered to ensure that the efficacy of the probiotic be maintained at all times, that the probiotic is not subjected to outside contaminants, and that the complete system can be easily taken apart and cleaned after operation.

In the case of the feeder, a sanitary design is used, complete with a closed hopper with specialized reverse pulse filter cleaning/venting in order to avoid any contaminants from entering the product. The conveying and transfer system is also designed for ease of access and cleanability. Specialized filter media, high polish material contact surfaces and tool-less design for dismantling are all available depending upon the specifics of the installation.

The Coperion K-Tron Advantage

- Coperion K-Tron's state-of-the-art SFT digital weighing technology delivers the high accuracy needed for maintaining control of the addition of costly and delicate ingredients such as probiotics.
- The SFT weighing technology features a resolution of 1:8,000,000 in 20 ms, as well as built-in immunity to fluctuations in plant vibration and temperatures.
- 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 the automated refill by Coperion K-Tron sanitary pneumatic receivers optimizes the system operation.

- All components in the system include a quick-clean design for easy disassembly, complete with fully welded and polished housings and triclover clamps/ferrules.
- All product contact parts are constructed to conform to strict cGMP and FDA standards.
- The Coperion K-Tron line of pneumatic receivers is also designed for cleanability and ease of 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 probiotic ingredients.
- Whether batching or continuous feeding, the Coperion K-Tron Systems Group can supply integrated systems including ancillary products, with one source management.



Loss-in-weight feeder with P-Series vacuum receiver

