



Application Example

Accurate and Gentle Feeding of Inclusions in Food Processes

Background

The growth of specialty artisanal foods with unique taste combinations has led to the increased use of inclusions in a variety of products. Inclusions are officially defined as food ingredients formulated to deliver a range of properties to the finished food product, including taste, texture, color and even added nutritional value. Inclusions can range from confetti in cake mixes to chocolate chips and nuts in confectionary products, or from bacon or dehydrated meat to chopped vegetables in snack foods. The growth of the plant protein market has also paved the way for the addition of nuts to many products, thus contributing a significant source of plant protein as well as the addition of crunch and color.

Inclusions can add not only texture, flavor and nutritional value, they can also be used to add moisture. Dried mushrooms, for example are often used in sauces and soups or fillings to absorb moisture and help ingredient binding properties.

Many of these specialty inclusions are also high in ingredient cost. For this reason, it is imperative that the method of delivery to the process below be extremely accurate and controlled, so that overfeeding is not experienced and control of these added costs can be maintained.

The use of Coperion K-Tron loss-in-weight (LIW) feeders for the accurate addition of inclusions to the process ensures a consistent flow of these high value ingredients, and more importantly, a higher control of ingredient costs. This application sheet focuses on the use of the new Coperion K-Tron LIW vibratory feeders for a wide assortment of inclusion materials.

Applications

Due to their fragile nature, or process requirements to main-

tain a specific size or shape, most inclusions are added as a final step prior to packaging. Such applications include various additions to a cereal line or the addition of chocolate chips to a granola bar line prior to baking, as well as many others. In the example shown in Figure 1 several different types of inclusions are added to a breakfast cereal on the conveyor below. Such inclusions can include nuts, marshmallow bits and various dried fruit pieces. The belt conveying the cereal is running at a fixed speed and the vibratory feeders are programmed to add the exact proportion of these components to the final product.

The feeders can be refilled by various methods, with everything from drums and boxes, to pneumatic transfer, dependent upon the exact product characteristics and refill rates required.

In applications where a low energy mixing step is needed, without further damage of the inclusions, such as the manufacture of various dry soup or cake mixes, LIW vibratory feeders are used to accurately deliver the inclusions directly



Photo 1: K3 V200 vibratory feeder in sanitary design



Photo 2: Inclusions come in all shapes and sizes

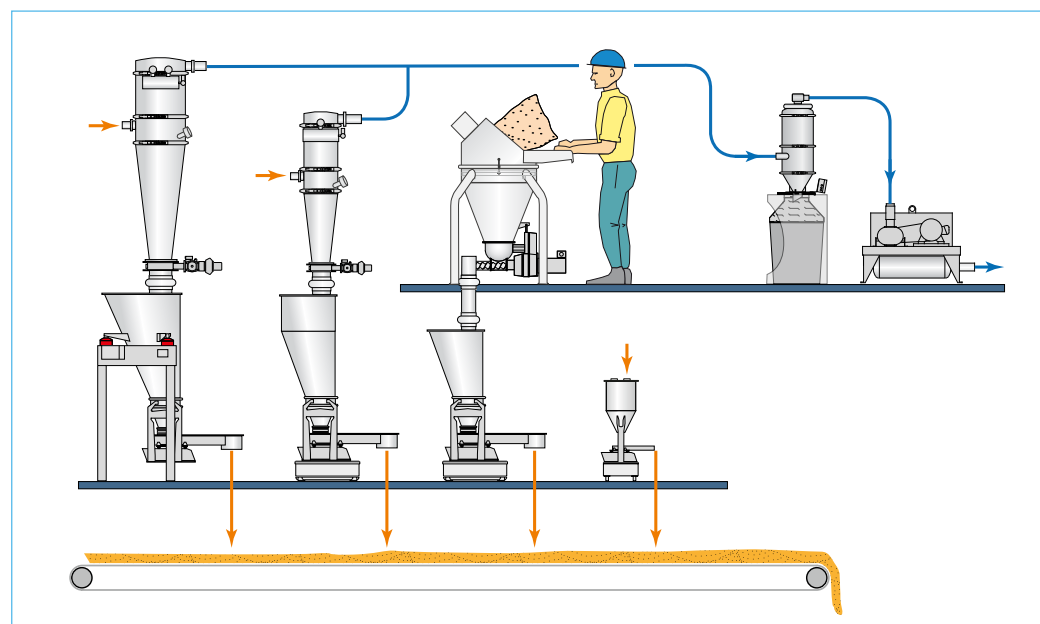


Figure 1: Process diagram showing the addition of inclusions to a breakfast cereal

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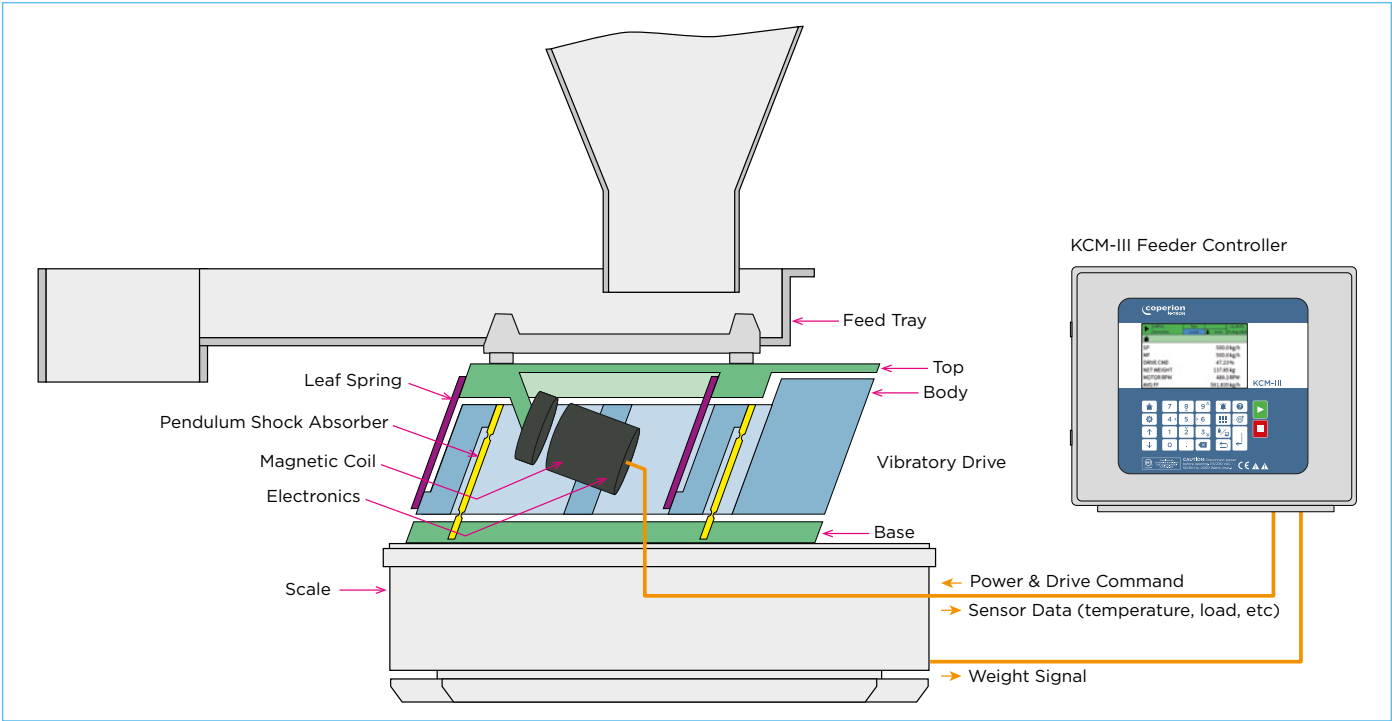


Figure 2: K3 Vibratory Feeder - Principle of operation

into the final blending step. These inclusions can include everything from dried vegetables to candy pieces. Depending on the process, inclusions may be added at the end of the blending cycle in order to minimize any degradation.

Vibratory feeders are often used in conjunction with LIW screw feeders. LIW screw feeders are used for the initial blend stages for the dry macro and micro ingredients such as flour, sugar, starches and flavors.

For more information on use of LIW screw feeders for blender operations see Application Sheet A-800316.

LIW Vibratory Feeder Operating Principle

With traditional volumetric vibratory feeding, the amplitude of the vibration is set based on calibration to maintain the volumetric flow of product within the tray. In LIW vibratory feeding, the entire feeder, hopper and material are continuously weighed. As the feeder

discharges material, the rate of decline in system weight is measured, and feeder drive amplitude is continually adjusted to maintain a consistently accurate true mass flow rate. The Coperion K-Tron K3 LIW vibratory feeder package consists of a feed hopper, feed tray and innovative new patent-pending vibratory drive mounted on a weighing system featuring the highly accurate Smart Force Transducer digital weighing technology and combined with the new KCM-III controls (see Figure 2).

The special vibratory drive design practically eliminates the transfer of vibrations to the surrounding equipment. Any residual interference of the drive vibration on the LIW signal is quickly filtered out using the advanced SmartConnex control technology. The combination of the KCM-III control with the special drive allows the new K3 vibratory feeder to achieve accuracies averaging 35% better over traditional technologies.



Photo 3: Vibratory feeder with ActiFlow smart bulk solid activator mounted at the back of the hopper and the control unit in the foreground.

Advantages of the K3 Vibratory Feeders

The key to achieving such high accuracy is the ability to deliver a continuous, even mass flow with minimal pulsations. The new K3 vibratory drive is able to achieve this due to a completely new shock absorber design. Conventional vibratory feeders use rubber or spring shock absorbers, which allow movement of the drive in all directions, resulting in rotational motion. In contrast to these conventional shock absorbers, the new K3 line uses a unique flexible pendulum technology which provides shock absorption only parallel to the desired direction of motion, eliminating rotational movement. This parallel motion ensures an even material flow of the product along the entire length of the tray.

The advanced control system and feeder electronics include internal sensors which measure acceleration, displacement, load, current and temperature at rates of up to 25,000 times per second. The fast-acting controller then adjusts the vibratory drive signal to maintain

clean sinusoidal displacement for optimal mass flow.

This unique drive design, together with the advanced control system, also results in extremely low energy consumption as compared to other feeding technologies. Power consumption can be as low as 20-30 Watts for feed rates as high as 6,000 kg/h, thus making it ideal for improved production sustainability and minimal heat dissipation.

The mechanical package is modular in design, and versatile in that it can accommodate custom tray configurations and lengths, ideal for a variety of inclusion ingredients and rates. Special quick-release clamps and bolts on the feed tray allow for quick product changeover.

The absence of mechanical wear parts results in lower maintenance requirements and ensures gentle handling of often sensitive or friable inclusions such as nuts, flakes or freeze-dried berries, for example.

The tray design also prevents any additional heat generation which can also be detrimental to heat-sensitive inclusions such

as chocolate chips or other high fat confectionary ingredients. Feed rates for the new vibratory feeders range from as low as 1 dm³/h up to 8500 dm³/h (0.035 to 300 ft³/h).

ActiFlow Smart Bulk Solid Activation

The new line of K3 vibratory feeders does not include any internal moving parts. Traditionally, horizontal and/or vertical agitators, whether horizontal or vertical agitators are often used in LIW feeders to help avoid product bridging or rat-hole formation in the feed hopper with bulk materials that are not free flowing.

As an alternative to mechanical agitation, which may damage or break these fragile inclusions, Coperion K-Tron has developed the unique ActiFlow™ Bulk Solid Activator. This innovative technology ensures maximum possible optimization of bulk material flow, is easy to clean and has no effect on material properties. Coperion K-Tron's patented ActiFlow Bulk Solid Activator reliably prevents the formation of bridges with even

the most poorly flowing materials. As shown in Figure 3, the system essentially consists of the ActiFlow device attached to the outside of the stainless steel hopper and the ActiFlow control module which closely interacts with the KCM feeder control module.

The ActiFlow device gently activates the material in the hopper with an optimized amplitude and frequency, which is continually adjusted as needed by the ActiFlow controller in combination with the KCM feeder control module, thus ensuring that there is always an optimal material flow in the hopper. This in turn provides for consistent and highly accurate feeding.

The advantages of ActiFlow over traditional vertical agitators as well as externally placed vibrators are not only time savings and cost reduction but also improved end product quality. The device is completely non-product-contact which eliminates cleaning and hygiene concerns. With a vertical agitator, there is still material left in the hopper after running empty. Customers report that cleaning is likewise much easier with the ActiFlow. Whereas the vertical agitator is laboriously removed for cleaning and therefore requires additional headroom above the hopper, there is no extra headroom required for the ActiFlow device that stays mounted on the feeder hopper.

In the set-up shown in Photo 3, the ActiFlow device is attached to the rear of the hopper. The red arrows show the direction of hopper activation. The position and direction of activation have been optimized during extensive feeder trials in the laboratory in order to minimize their effect on the weighing system and at the same time maximize the flow of bulk material.

The advanced SmartConnex filtering algorithms in the KCM feeder controller effectively filter out extraneous vibrations, including those created by the

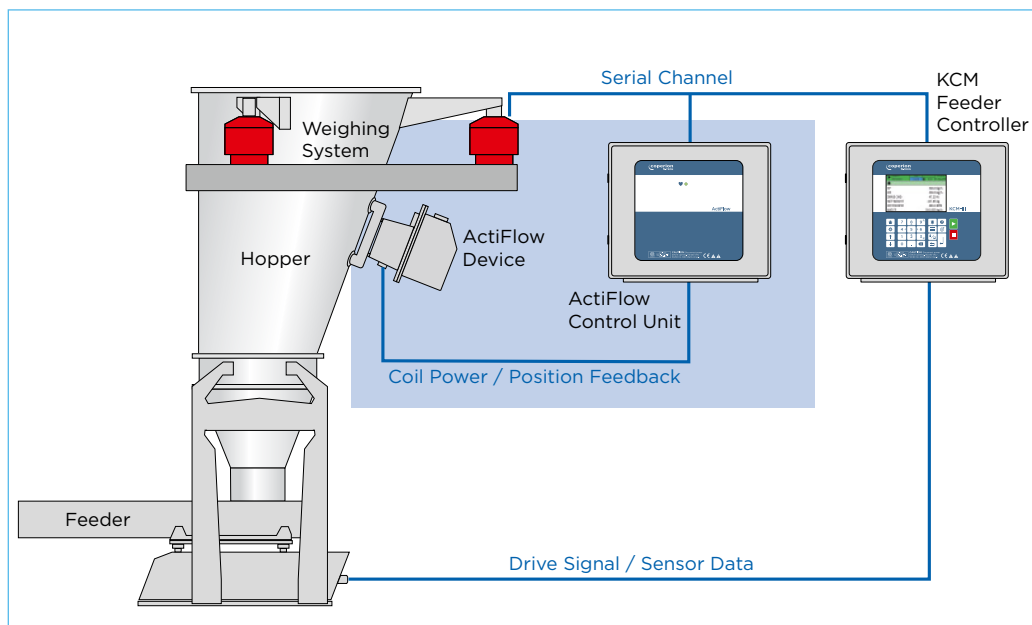


Figure 3: ActiFlow Principle of Operation - The ActiFlow control unit works closely with the KCM loss-in-weight feeder controller to automatically recognize how much activation is needed to keep the bulk material moving.

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ActiFlow device, thus ensuring an exact weight signal at all times — even when the ActiFlow's activation of the bulk material is at maximum.

Act Instead of React

Why is the ActiFlow better than traditional external vibrators? The most important concept underlying the ActiFlow system is to act instead of react. This is especially important when differentiating it from traditional vibrators or “knockers” which may simply be placed on the outside of the hopper.

The feeder control module has the ability to recognize deteriorating material flow in the hopper before a possible mass flow error occurs. In this situation, the ActiFlow increases the amount of vibration applied to the hopper wall, activates the bulk material flow and prevents feed rate errors.

As soon as the control module detects normal material flow, the ActiFlow reduces the activation of the material again. The control system and weigh module are using actual real-time performance data to activate and control the level of vibration. Owing to a specially developed patented control algorithm the ActiFlow only activates the material in the hopper as much as necessary and not as much as possible. A sensor

integrated into the ActiFlow is an additional distinctive feature that functions as a positioning feedback device for the control module. The activation amplitude and frequency can thus be monitored and regulated precisely. This precise real-time control ensures that the vibration does not cause additional packing of the material within the hopper, a common occurrence with traditional vibrator technology.

Hygienic Design / Quick Changeovers

The overall design of the new K3 vibratory feeder line is modular in concept and allows for quick product changeover. In addition to the standard design, a line of hygienic, easy-clean configurations is available. These include a hygienic silicone cover to enclose the complete drive assembly, making it suitable for food and pharmaceutical applications, even in washdown situations. The vibratory tray is configured with a quick release mechanism for fast material contact changeovers, making it ideal for the use of feeding allergens. The hygienic design of the new vibratory feeder is FDA compliant, and is supplied as Food CE in accordance with EN1935/2004.

Conclusion

The global food inclusions market is growing rapidly. The rising preference for people to lead a healthier life and have a healthier diet has increased the demand for inclusions with high nutritive value, while the rising demand for processed foods with increased value such as newer taste profile products have also increased inclusion demand. The increasing demands of the “foodie” population with more increased disposable income as well as a desire for more innovative recipes have contributed to this growth. The use of the Coperion K-Tron K3 vibratory feeder with its new technology allows for highly accurate addition of these inclusions to the food process, thus minimizing product waste, optimizing inclusion ingredient costs, and also improving overall product quality. This revolutionary new generation of Coperion K-Tron loss-in-weight vibratory feeders also offers gentle handling of the bulk material and faster product changeover, resulting in even better product quality as well as less production downtime for increased operational efficiency.

The Coperion K-Tron Advantage

- 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 feeding and transfer.
- Feeding solutions with high energy efficiency
- Engineered material handling and feeding solutions from both Coperion and Coperion K-Tron reflect extensive experience in hygienic and sanitary design standards, including CIP/COP, EHEDG, FSMA, GFSI, USDA, and 3A where applicable
- Superior global service network to ensure 24-7 support and coverage of your complete inclusion process for one source supply.
- The K3 line of vibratory feeders ensures gentle handling of the product and less waste, as well as low energy consumption and high accuracy
- Coperion K-Tron SmartConnex control capabilities to allow for a variety of programming options including ingredient control and recipe management



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