Case History

February 2014

Contact
Shari Lake
Marketing Manager
Coperion K-Tron Salina, Inc.
606 North Front Street
Salina, KS 67401 USA

Tele (785) 825-3884
slake@coperionktron.com
www.coperionktron.com

Saratoga Food Specialties

Automated Feeding & Material Transfer for Efficiency & Improved Product Quality

Introduction:

Saratoga Food Specialties, Bolingbrook, IL, has been developing and producing unique and quality dry seasoning blends for over 60 years. With a product array of over 500 different blends, a growing customer base, and a goal to deliver consistent output through facilities optimization, Saratoga quickly realized the need to automate their dry seasoning blend operation. When a significant client required increased capacity for their seasoning blend, Saratoga turned to the Systems Design Group at Coperion K-Tron for help.

Objective:

The original method of production for the seasoning blend included labor intensive batch weighing and transfer of each of the individual ingredients as well as the addition of fiber to the final blend prior to packaging. All weighing and transfer of these ingredients was done manually. This operation had limited flexibility in capacity and also required long production time due to the manual stages of the process. In addition, when recipe changes were required for the different blends, the changeover time further extended the production time.

Application & Process Details:

In response to Saratoga's request, Coperion K-Tron's overall system design includes a two stage blending step with the primary preblend of spices done in a batch blender. This preblend is then conveyed pneumatically directly from the blender via dense phase vacuum conveying to a Coperion K-Tron vacuum receiver above a Coperion K-Tron loss-in-weight feeder.

A second processing line, complete with a mechanical conveyor transfers the fiberous material directly to a second Coperion K-Tron loss-in-weight feeder. Both feeders are controlled through individual Coperion K-Tron Control Modules (KCM's) with direct links to an overriding HMI, the K-Vision™ Line Controller, complete with recipe control.

Depending upon the recipe chosen, the control system directs the correct proportion of spice blend/ fiber to be delivered by the loss-in-weight feeders to the continuous mixer below. The highly accurate load cells of the Coperion K-Tron feeders ensure that the precise amount of ingredients is supplied to the process without excess or waste. The two loss-in-weight feeders supplied include a single screw and a twin screw design, with one being constantly refilled by a flexible screw conveyor, and the other via the Coperion K-Tron pneumatic conveying system. Consistent refill of the loss in weight feeder and correct integration into the overall material handling system is imperative in order to achieve efficient product quality.

The added ability to control required setpoints and ingredient proportions through the Coperion K-Tron controller allows for added versatility, with the ability to change recipes quickly and easily. Most importantly, the automated transfer of all the components reduces labor and overall process time, while allowing Saratoga to more than triple their capacity in the production line, with a significant increase from 2,000 lb/hr to 6,250 lb/hr.

Why Coperion K-Tron Loss-in-weight Feeders in the Continuous Blending Process?

When designing any continuous process, the method of delivery of the individual ingredients is critical to the resultant product quality. For this reason, highly accurate Coperion K-Tron gravimetric feeders were the feed method of choice.

By definition, gravimetric feeders measure the material flow's weight in one fashion or another, and then adjust feeder output to achieve and maintain the desired setpoint.

The Loss-in-Weight Principle of Operation

The most popular type of gravimetric feeder used in continuous processes is the loss-in-weight feeder. Loss-in-weight feeders directly measure and control to the process variable of flow rate and can fully contain the material within the confines of the feeder. Loss-in-weight feeders are typically either mounted on weigh scales or suspended from load cells.

At Saratoga, both of the Coperion K-Tron loss-in-weight screw feeders were suspended from Coperion K-Tron SFT load cells. This suspension design not only helps with overall layout requirements but also allows for a larger infeed hopper and material load.

The Coperion K-Tron load cell is a highly accurate instrument, designed specifically for the rate and accuracy requirements of dynamic feeding, and includes a resolution as high as 1: 4,000,000 in 80ms. A loss-in-weight feeder consists of a hopper and feeder that are isolated from the process so the entire system can be continuously weighed. As the feeder discharges material, system weight decreases. The speed of the metering device is controlled to result in a per–unit-time loss of system weight equal to the desired feed rate. A typical loss-in-weight feeder controller adjusts feeder speed to produce a rate of weight loss equal to the desired feed rate setpoint.

In the plot of weight vs. time, feed rate setpoint is represented as a downward sloping line. The negative mathematical slope ($\Delta W/\Delta T$) indicates the desired loss of system weight per unit time. The feeding cycle begins with a fully loaded hopper where weight is at a maximum. As feeding proceeds the measured weight is continually compared against the setpoint line's target weight. Any difference between the two values triggers a change in feeder speed. For example, if an overfeed condition occurs due to an abrupt increase in material density, sensed weight falls below desired (setpoint) weight, triggering a reduction in screw speed to return to the setpoint value. Additionally, since the integrated error associated with the overfeed is known, screw speed may be further reduced to immediately and precisely compensate for the overfeed condition. The opposite occurs with an underfeed condition.

Loss-in-weight 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 (which is 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 material are compensated by modulation of the screw speed. With this technology, a constant mass flow is ensured, thus also ensuring for consistent product delivery to the blender below.

Automated Transfer of the Spice Blend for Loss-in-Weight Feeder Refill:

Dilute vs. Dense Phase?

At Saratoga Foods, the transfer of the primary spice blend from the batch blender is done by dense phase vacuum conveying. In dense phase operations, a reduced gas velocity range of 80 CFM to only 1700 CFM is utilized. Due to this lower gas flow, the conveyed spice blend is subjected to a much gentler action. This gentle action also reduces the segregation issues often experienced with the more aggressive dilute phase operation

Typical dilute phase conveying operations are suitable for materials where segregation or attrition in the conveying line is not a concern. Comparitive velocities in a 3 inch pipe for dilute phase can range from 300 cubic feet per minute (CFM) to up to 7000 CFM. With those velocities, it's easy to understand why Saratoga made the decision to convey their delicate spice blend utilizing dense phase conveying, thus saving the integrity of the mix.

Dense Phase Principle of Operation

By definition, dense phase means a higher product to gas ratio, or a smaller amount of gas is used to move a large quantity of product. The lower the gas requirement, the lower the power consumed by the exhauster or vacuum pump. Typically material is picked up from the outlet of a bag dump or specialty hopper, which creates a pressure differential and allows slugs of product to form. Dense phase generally fits into two phase or piston flow characteristics.

In addition, the hopper also includes a type of makeup air inlet, which aids in the forming of the slugs as they travel and pulse through the conveying line. The combination of the relatively low air velocity and an expanded line size result in a type of “siphon-like” effect for conveying to the vacuum receiver, with less resultant attrition and segregation.

In the case of Saratoga Food Specialties, the material is delivered directly to a Coperion K-Tron P100 vacuum receiver which allows for the break of the vacuum and the release of the material from the gas stream. This receiver includes a reverse jet filter, which is pulsed when the vacuum breaks to allow for cleaning of the filter media.

The outlet of the receiver is fitted with a slide gate discharge valve. This valve is sequenced to open after the vacuum breaks and the filter has been pulsed, thus delivering product to the Coperion K-Tron loss-in-weight feeder below.

Summary Advantages of Loss-In-Weight Feeding and Pneumatic Conveying for Seasoning / Spice Delivery Applications

Today’s food manufacturers are continually striving for methods to maintain and improve product quality while controlling overall manufacturing costs. Saratoga Food Specialties is a prime example of a food processor succeeding by utilizing highly accurate Coperion K-Tron loss-in-weight feeders and the automation of material handling through the use of Coperion K-Tron P-Series vacuum sequencing receivers. This design, resulted in tripling their existing line capacity!

By accurately controlling the seasoning delivery, there is significant reduction in the delivery of excess ingredients, thus also controlling high value ingredient cost and improving overall product. The added transition from a manual to an automated transfer of product has allowed Saratoga to significantly increase their production capacity. As stated by Jim Bejna, Director of Operations, Saratoga Food Specialties, “The accurate and efficient system as provided by Coperion K-Tron has improved the overall versatility of the seasoning line, and has also allowed Saratoga to meet the growing capacity demands of our customers. In addition, the added reliability of the Coperion K-Tron control system provides a validatable method of feedback that the system is making product correctly, in both product quality and required quantities.“