BEST COMPONENTS
BETTER SYSTEMS

THE RECIPE FOR PERFECT FOOD

coperion
K-TRON

Application Example

Feeding and Conveying in Tortilla Production

Background

The overall consumption of tortillas has grown at a steady pace in recent years due to their increasing popularity in various cultures and countries as a favorite snack and meal option. In the US, tortillas have emerged as one of the fastest growing bakery products – second only to sliced bread in terms of sales. There are basically two types of tortillas: wheat-based and corn-based.

In the production of wheat flour tortillas, the raw ingredients are transferred to a large mixer where they are combined to create the dough.

Corn tortilla production starts with a process called nixtamalization, in which the corn is soaked in an alkali solution of lime (calcium hydroxide) and hot water. Nixtamalization removes the hard outer hull from the kernel, making it easier to grind and the resulting dough more flexible. It also improves the flavor and aroma of the final corn flour blend product.

The chemical changes resulting from the cooking and soaking also increase the nutritional value of the corn flour by increasing levels of calcium, iron, copper, zinc, and releasing niacin and essential amino acids while also reducing the content of mycotoxins (toxins resultant from molds that commonly infect maize).

After the corn is fully cooked, it is allowed to steep and then washed and coarsely ground to create a paste called masa or nixtamal (based on the Aztec words for 'ashes' and 'unformed corn dough'). Corn tortillas

can be prepared directly from nixtamal, from nixtamalized cornflour, or from a mixture of the two.

In both types of tortilla production, pneumatic transfer via both pressure and vacuum is used as a method of delivery of the raw ingredients to the cookers and mixers. Volumetric screw feeders are used to accurately dose the lime to the nixtamalization process.

Since tortillas are rapidly becoming a mainstream staple they are often fortified. In this case screw feeders are used for the dosing of vitamins (iron, zinc, thiamin, riboflavin, niacin and folic acid) to the corn and wheat flour tortilla premixes.

In this application example we will examine the details of the corn tortilla process. However, it should be noted that the same principles of conveying and feeding are applied in the wheat flour tortilla process.

Corn Flour Production

At the start of the facility, dried corn kernels typically arrive by truck and are mechanically transferred to bins after going through a scalping and screening stage. The clean, unprocessed corn is then sent to "clean corn bins" for intermediate storage. Broken corn and dust particles are screened out during this process and generally re-processed for animal feeds.

The clean corn is then transferred directly to a scale hopper, which is used to batch out the corn before entering the steamer/cooker. This batching method allows for accurate delivery of the corn kernels to the steamer, with an expected accuracy of approximately ±0.5% of full scale capacity.

The cooker/steamer system uses an alkaline cooking process, whereby the corn is cooked in a lime-water solution for a period of time to create nixtamal.

The lime solution is made by adding powdered lime to the cooker by means of a volumetric screw feeder. The lime powder is transferred to the feeder using a vacuum conveying system: the lime is picked up from a bag dump station and transferred to a vacuum receiver mounted over the feeder hopper.

Coperion K-Tron vacuum receivers are designed to convey a wide variety of food materials and are available in painted carbon steel, aluminum and stainless steel construction. Conveying rates range from 270 to 6800 kg/hr (600 to 15,000 lb/hr), depending on the model

Scale hopper with Aeropass valve

Aerolock™ rotary valve

and configuration. Coperion K-Tron vacuum receivers can be used for general pneumatic transfer applications or as refill devices for Coperion K-Tron feeders.

Once the corn is cooked and separated from the hulls, it is transferred to a large volume tempering bin. The tempered corn exits the bin and is metered via belt feeder into a hammer/grinding mill. Here the corn meal is ground into Nixtamalized Corn Flour (NCF) with carefully controlled particle size distributions in order to meet the various product requirements. For example, the flour used for tortillas needs to be finer than those used for tortilla chips and taco shells.

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Next the corn flour passes through a series of screening, grinding, sifting and aspiration steps to separate it into the desired finished grades.

Coperion K-Tron can provide the entire range of conveying components and material handling equipment for all of these stages, including comprehensive systems engineering. The final conveying stage delivers the fine ground corn flour to storage silos. From there the corn flour is either transported to the tortilla production line or to PD trucks or packaging lines for delivery to other plants.

Tortilla Production

The final corn or wheat flour mix can be used for commercial or home tortilla production.

For wheat flour tortilla production, mixed and enriched flour blends are combined in a large mixer to create the dough, which is fed through a rounder to create small round dough balls by weight. The dough balls are pressed or hand shaped into flat tortillas. If the press method of shaping is used, the tortillas are flattened by two hot plates. If the tortillas are hand stretched, the dough balls are fed through a roller that flattens the balls into an oblong shape. The ovals are then manually stretched into a circular shape. The raw tortillas are cooked in an oven, and immediately cooled, before being packaged and sold.

For corn tortilla production, the corn flour blend is rehydrated in a mixer to create the corn paste, or masa. The masa is then pressed into a thin sheet, cut into circles and finally cooked in an oven. The corn tortillas are then cooled to prevent over-baking and sent to the packaging line.

Conveying Technology

Dilute Pneumatic Transfer - Positive or Negative Pressure

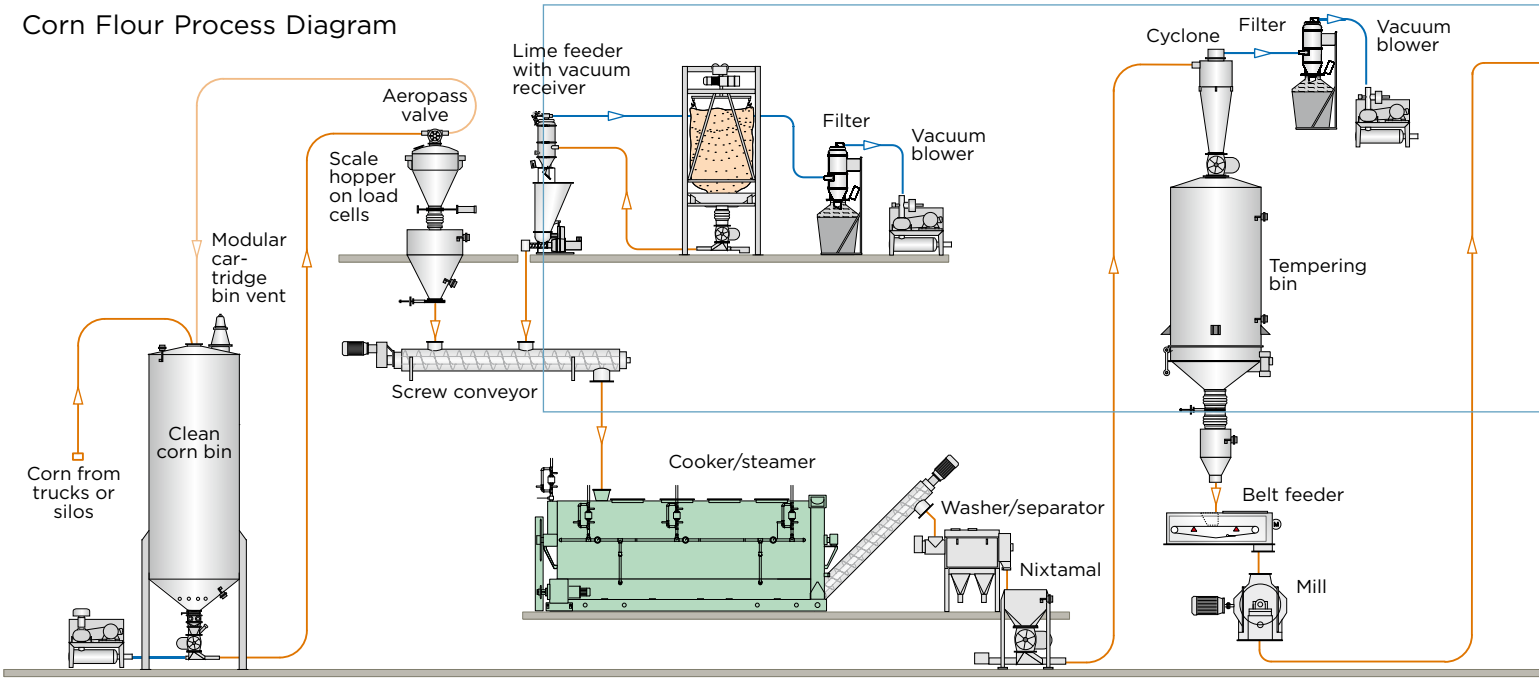
Throughout the entire process Coperion K-Tron pneumatic conveying systems are used to transfer the milled, separated, sifted and ground corn flour. The process may include both pressure and vacuum dilute conveying systems, depending on the conveying distances, material characteristics and conveying rates required.

Pressure conveying systems are typically used to transport product over long distances at high throughputs. In this case positive pressure PD blowers are used for the delivery of the heated and cooled corn material to cyclones. Pressure conveying is also often used for loading and unloading large volume vessels such as silos, cyclones, railcars, trucks and bulk bags.

Vacuum systems are often used for lower volumes and shorter distances. One of the advantages of vacuum systems is that the inward suction created by the vacuum blower eliminates any outward leakage of powder. This is one of the reasons why vacuum systems are often used in applications with strict hygiene or dust containment requirements.

Stainless steel filter receiver

Corn Flour Process Diagram



Another advantage of vacuum systems is the simple design for multiple pickup points. It should be noted, however, that due to the limitations in the level of vacuum that can be generated, the distances and throughputs on a vacuum system may also be limited. Often a combination of pressure and vacuum conveying designs are used for a system, taking full advantage of the efficiencies of each technology.

Feeding Technology

Vitamin Fortification Process

The flours used in production of both corn and wheat flour tortillas are often fortified with vitamins, which are generally added to the process in the form of a dry premix.

Vitamin A is most commonly used in the fortification of flour. However, other vitamins, such as thiamin, riboflavin, niacin and folic acid may also be added. Screw feeders are generally used to dose a premix of these enrichment compounds into the corn flour.

Volumetric or Gravimetric Screw Feeders?

Coperion K-Tron screw feeders can be supplied in both volumetric and gravimetric configurations. Volumetric screw feeders run at a fixed set speed and the actual material flow rate is determined by taking samples, calculating actual flow rate and manually adjusting the speed of the feeder to achieve the desired flow rate. Gravimetric loss-in-weight (LIW) feeders are controlled automatically by measurement of actual weight loss in the system compared to a desired flow rate and adjustments in screw speed are automatically made by the feeder controller. In cases where a high level of accuracy is required, loss-in-weight feeders are highly recommended.

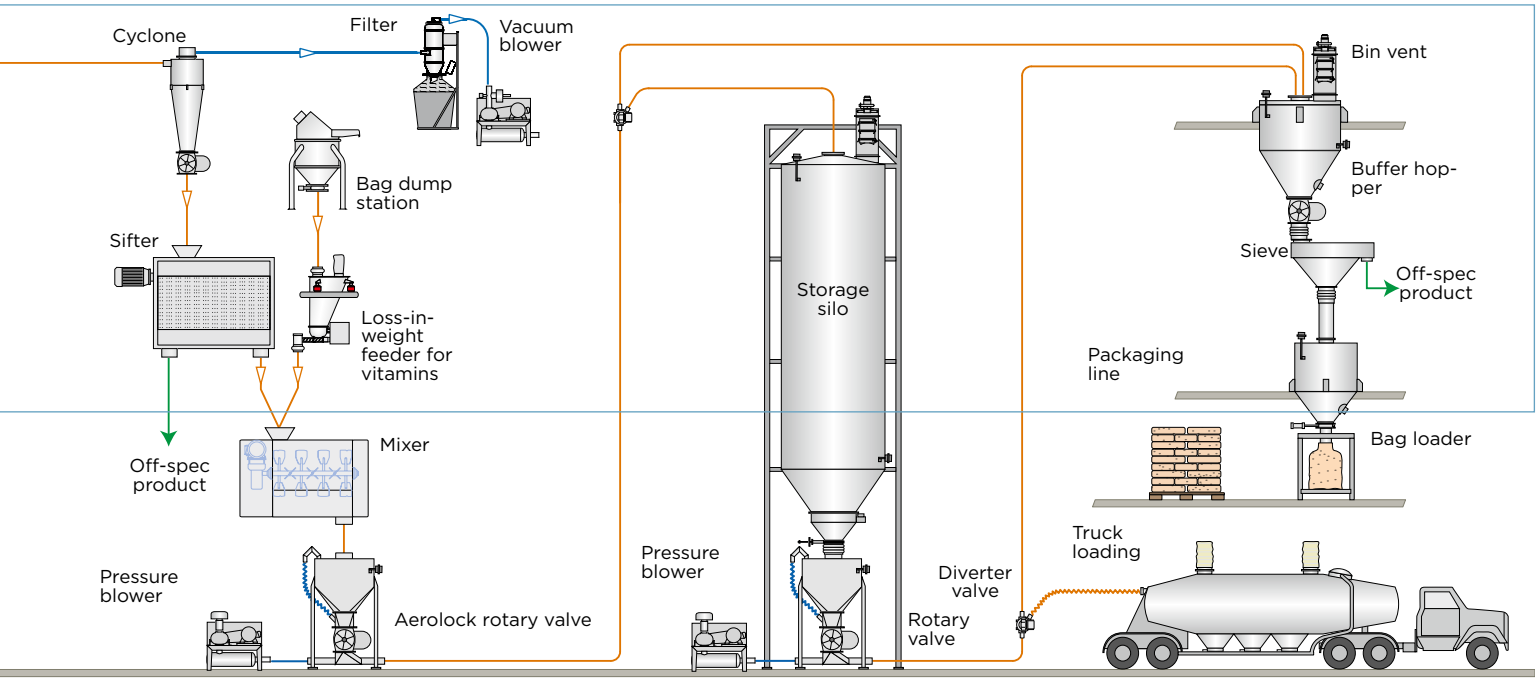
For example, when feeding materials with high variations in bulk density, or when feeding cohesive non-uniform flowing materials or materials of variable moisture content, a volumetric screw feeder running at a fixed speed will not be able to maintain a desired flow rate with any degree of accuracy. However, a gravimetric LIW feeder will compensate for the variation in bulk density, or non uniform flowing material or variation in moisture content by automatically adjusting the screw speed in order to maintain a desired flow rate within ± 0.5% accuracy. 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 4,000,000 resolution in 80 ms, vibration filtration and temperature compensation which allows the feeder to be controlled on a second to second basis with unprecedented performance levels. Thus gravimetric feeders have essentially no fluctuations in feed rate.

Weigh Belt Feeders

While volumetric feeders are sometimes used to add the lime to the process, a more efficient solution is the use of a weigh belt feeder (WBF) to gravimetrically feed the lime. Weigh belt feeders are used for the continuous controlled gravimetric feeding of bulk materials and can be used for either gravimetric batch feeding or continuous metering of a bulk material flow.

K2 modular loss-in-weight feeder

The Coperion K-Tron Smart Weigh Belt feeder features a primary weigh bridge with state-of-the-art SFT weighing technology located below a continuously rotating belt. A second weigh bridge can be installed for automatic online tarring. As shown in the graphic, as material falls onto the belt, the weight of the belt with material is measured by the primary weigh bridge, while the second-



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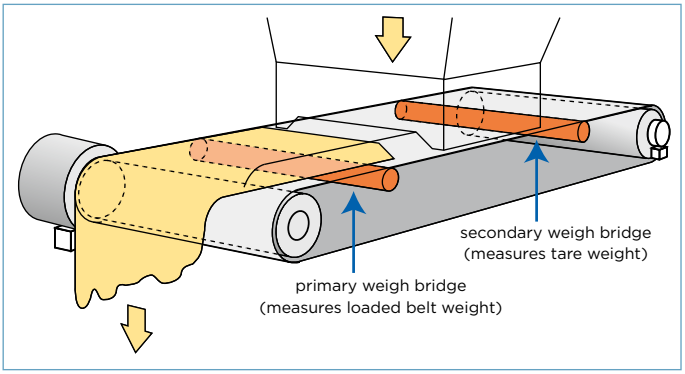
ary weigh bridge measures the weight of the empty belt (tare weight). This is particularly useful for cohesive materials that may cause buildup on the belt.

The feeder controller automatically tares out the weight of the belt (and any material buildup) and compares the desired mass flow (setpoint) with the actual mass flow, adjusting the belt speed accordingly. The combination of the highly advanced weighing technology and the detailed control algorithms provide for high accuracy metered feeding of the product to the process.

Coperion K-Tron Advantage

- Coperion K-Tron 2400 series vacuum receivers are designed to handle a wide variety of materials, from free flowing to difficult-to-handle fine powders
- All receivers and components are designed with ease of maintenance and accessibility for cleaning in mind.
- Additional design options are available in the P-Series of pneumatic receivers for specialty sanitary applications.
- Coperion K-Tron Aerolock rotary valves include a variety of sizes and design options depending on the application. They also meet most USA and European hazardous location requirements and are CE compliant.
- Each project is developed according to the process application using Coperion K-Trons' extensive experience in providing material handling solutions that include ancillary products, thus providing single source management and responsibility.
- A Coperion K-Tron Systems Engineer is assigned to a project at the proposal development stage and continues to be responsible for the project through installation and commissioning thus providing a single contact for the customer.

  Coperion K-Tron's state-of-the-art SFT digital weighing technology delivers the high accuracy requirements needed for maintaining control of the addition of costly ingredients.
- The Coperion K-Tron Control Module (KCM) provides integrated control of motor, weigh bridge and drive functions.
- Trained, certified service engineers located around the world provide 24-hour technical support to solve your problems any time, any day.



Coperion K-Tron Smart Weigh Belt feeders offer an optional secondary weigh bridge

Coperion K-Tron Smart Weigh Belt feeders are available with and without housings

Main offices:

Coperion K-Tron Salina, Inc.
606 North Front St.
Salina, KS 67401, USA
Tel +1 785 825 1611
Fax +1 785 825 8759

Coperion K-Tron Salina, Inc.
Sewell Office
590 Woodbury-Glassboro Rd
Sewell, NJ 08080, USA
Tel +1 856 589 0500
Fax +1 856 589 8113

Coperion K-Tron (Switzerland) LLC
Lenzhardweg 43/45
CH-5702 Niederlenz
Tel +41 62 885 71 71
Fax +41 62 885 71 80

info@coperion.com