

TECHNICAL ARTICLE SERIES

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AA-0726

Mechanical and Pneumatic Conveyors Both Prove Best for New "Chocolate Dodger" Process at Burton's Biscuit



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LLANTARNAM, WALES — Burton's Biscuit Co., a leading U.K. producer of biscuits and snack products, is best known for their "Jammie Dodger" sandwich made of two shortbread biscuits with jam in the centre. To build on the product's success, the company decided to market a "Chocolate Dodger" version, made of chocolate biscuits with chocolate cream in the center.

To produce the chocolate cream, the plant installed a batching/blending system consisting of flexible screw conveyors that transport cocoa powders to a horizontal paddle mixer, and a pneumatic conveying system that delivers finely milled sugar to the mixer. Both conveyors that were designed to overcome potential challenges associated with the materials, were supplied by Flexicon (Europe) Ltd., Whitstable, Kent.

A PLC controls the gain-in-weight batching/blending process, in which the cocoa powders, milled sugar, palm oil and liquid chocolate are added in sequence to the mixer. Load cells supporting the mixer transmit weight gain signals to the controller, which starts and stops the conveyors and the mixer, and opens/closes valves, to automatically batch and blend the chocolate cream.

Dual flexible screw conveyors move difficult-to-handle cocoa powder

Cocoa powder has a bulk density of approximately 560 kg/m³ and is non-free-flowing. The material has a tendency to pack, cake, and form deposits on conveying equipment surfaces, particularly if exposed to moisture since it is also hygroscopic. In addition, it fluidises readily, and generates dust.

To move the troublesome material consistently while containing dust, the company specified two Flexicon flexible screw conveyors with screw geometry suited for the application.

The chocolate cream recipe calls for 15 kg of one type of cocoa powder, and 25 kg of another, both of which are manually dumped from 25 kg bags into a twin floor hopper that keeps each type separate.

The twin hopper consists of two narrow hoppers joined at a centreline, from which a hopper lid hinges to cover the opening of one hopper or the other. The lid also doubles as a shelf to support bags during slicing and dumping.

A wire screen with 50 mm square apertures spans both hopper openings to prevent the passage of bag scraps.

Dean Miles, Burton's Biscuits' engineering projects manager, explains that a vacuum extraction system connected to both hoppers withdraws any fugitive dust generated from dumping activities.

The hoppers are also equipped with an electromagnetic vibration system that promotes flow of material into the inlets of flexible screw conveyors that transport cocoa to the mixer.

Each conveyor consists of a stainless steel flexible screw, housed in a 3 m



Two cocoa powders are transferred from the twin hopper through each flexible screw conveyor to the mixer, while sugar enters the mixer from pneumatic receiving hopper above. The entire batching/blending process is controlled by PLC.



long, 90 mm O.D. plastic tube that is inclined at 70°. From the discharge spouts of both conveyors, material flows to a common wye fitting and then through a single downspout that discharges into the mixer.

The screw is driven by a 2.2 kW motor located above the discharge point of the tube, thereby preventing powder from contacting drive seals.

The screw is engineered with special geometry to minimise radial forces and maximise longitudinal flow of the material to prevent packing of the compressible material. As the flexible screw rotates, it self-centres within the tube providing clearance between the screw and the tube wall to minimise grinding or heating/melting of the powder.

The conveyors are started and stopped by the PLC to move 15 kg of one cocoa powder, and then 25 kg of the other, to the mixer. Each conveyor moves material at the full feed rate of 1.85 m³/h, and then steps down to trickle feed rate before stopping, once the accurate target weight is gained by the mixer.

Hygroscopic sugar conveyed 200 metres pneumatically without plugging

Unlike cocoa powder, the sugar powder needed for the process is free-flowing (when dry) and is sourced from a distant plant location, leading Burton's to specify a PNEUMATI-CON® pneumatic conveying system, also from Flexicon Europe.

The plant receives sugar in granulated form, which is milled to a fine powder, and then fed from a hopper through a rotary valve into a 200 m long, 75 mm diameter stainless steel pneumatic line.

Powered by a blower located upstream from the sugar intake point, the pneumatic conveyor has a capacity of 2,110 kg/h. Since the fine powder will readily agglomerate and block the line in the presence of moisture, a key requirement is to keep the sugar warm and dry — achieved by means of a de-humidification system. Miles points out that this is especially critical because the pneumatic line contains four 90° elbows and four 30° elbows where plugging would otherwise occur.

A 915 mm diameter filter receiver separates the sugar from the air stream, before it enters a 500 kg capacity receiving hopper, located above the mixer. Four air-jet fluidisers in the bottom of the hopper promote the flow of material as it is fed into the mixer by a rotary valve under PLC control, according to weight gain input provided by the mixer's load cells.

Just before entering the mixer, the sugar passes through a 915 mm diameter vibratory screen with 1.0 mm openings, which retains oversize material.

Once palm oil and liquid chocolate are added to the batch, the PLC cycles the mixer, opens a discharge valve, and pumps the chocolate cream blend to the sandwich production line.

Two-stage ordering process proves successful

Initially, Burton's Biscuits ordered the pneumatic system, which was the more critical of the installations because of the distance the sugar had to be conveyed. "Flexicon started the installation two months after we ordered it," says Miles. "At that point we had confidence in the company, so we ordered



Two types of cocoa powder are emptied into the twin hopper while dust is removed by vacuum. The two flexible screw conveyors move each powder, alternately, to the mixer.



the flexible screw conveyor system and started producing the chocolate cream and Chocolate Dodger sandwiches two months later."

"Flexicon met the lead times we were dealing with and their price was competitive," says Miles.

The equipment is inspected only once a month and requires minimal attention, according to Miles. "We run residual material out at the end of every production run and wipe down the hoppers and connecting pieces for the delivery pipe work and screw feeder. If we need to clean a flexible tube we can take it off and clean it in 10 minutes." He adds, "It's the right kind of system for us and it works well. We can load it up and leave it to look after itself."



Sugar flows from the floor hopper through a rotary valve into 200 m long PNEUMATI-CON® pneumatic conveying line powered by the blower above the hopper.



Sugar is fed into the mixer below from the 500 kg pneumatic receiving hopper. At left, cocoa powder enters the mixer through the discharge end of the flexible screw conveyor and downspout.





Cocoa powder (top) and finely milled sugar (centre) are blended (bottom) in a horizontal paddle mixer before palm oil and liquid chocolate are added to the batch, producing a chocolate cream blend that is pumped to the sandwich production line.



The batching/blending system produces Burton's new Chocolate Dodgers product.

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