SMART CONVEYORS ENABLE GENTLE HANDLING AND HIGH THROUGHPUT IN THE PRODUCTION OF FROZEN READY MEALS

Manufacturers of frozen ready meals now have the option of smarter conveyor systems, specifically designed for gentle tray handling and the flexible needs of their manufacturing and packaging lines. By Todd Eckert, Inside Sales Manager, Shuttleworth, division of ProMach.

FROZEN ready meals are highly popular in the packaged-food market due to their convenience and portability. Time-pressed consumers are searching for convenient products that are simple and easy to prepare, as well as healthier choices with products containing natural and organic ingredients. Frozen ready meals are continuing to fill this need.

The global ready meals market size was valued at USD 159.15 billion in 2019, per a May 2020 Market Analysis Report prepared by Grand View Research, with expected growth at a compound annual growth rate (CAGR) of 5.5 percent from 2020 to 2027. In 2019, the ready meals segment accounted for 34.6 percent of worldwide frozen food sales, according to a 2020 report from Allied Market Research.

Additionally, the impact of Covid-19 has had a direct influence on the consumption of ready meals in the U.S. According to the American Frozen Food Institute, in one month, April 2020, sales of ready meals were up 50 percent over the same month in 2019. Demand for frozen ready meals has spiked as purchasing from restaurants and other foodservice options diminished because of social distancing mandates and restaurant closures.

This increasing demand for frozen ready meals has pushed manufacturers to implement more streamlined and cost-efficient technology for processing and packaging, to increase uptime and throughput.

READY MEAL PRODUCTION, EVOLVING TECHNOLOGIES

The technology for the preparation of ready meals has been in the making for quite some time—96 years to be exact, starting with Clarence Birdseye, who in 1925 invented the double-belt freezer, a machine for freezing packaged fish that would revolutionise the storage and preparation of food. In 1945, Maxson Food Systems used Birdseye's technology to sell the first complete frozen dinners to airlines.

Eight years later, in 1953, a Swanson company salesman named Gerry Thomas, came up with the idea to combine turkey with other staples like cornbread stuffing, buttered peas, sweet potatoes and gravy, then cook it, package it and freeze it in an aluminium tray similar to those used by the airlines. It was intended to be warmed up straight in the oven, and be eaten in while watching television, which was just then exploding in popularity in homes across America. Hence, the TV dinner was born, and so was the ready-meal frozen food category. In 1954, the first full year of production, Swanson sold ten million TV dinners.

Since then, the technology for making ready meals has only gotten better. Continuous-process systems for cooking and cooling enable the handling of higher throughput volumes; PLCs more precisely manage process time, temperature and production flows, aided by split-second, precision motions from servo-motors and actuators; HMI-controlled recipe management ensures more consistent processing and packaging results; and vision systems ensure rejects are caught before making it through to the consumer.

These technologies have been integrated into all processes involved in the filling, cooking, lidding freezing and packaging of ready meals. Critical to connecting these processes are conveyor systems that must transport the ready-meal trays, starting, stopping, redirecting, accumulating and indexing them into the downstream machinery with high precision.

CONVEYING READY MEALS POSES CHALLENGES

Moving food-filled trays throughout a filling and packaging line involves multiple sequential operations requiring precision and careful handling. The line typically starts with empty trays entering the conveyor, then the trays are moved to one or more food filling stations, and on to induction into ovens for cooking. The now cooked and hot ready meal trays are conveyed into a freezer, and when the desired temperature is reached the trays are moved out for primary and secondary packaging, including labelling, coding, shrink wrapping and cartoning.

For conveying systems moving food filled trays between these processes, significant challenges must be overcome to maintain product integrity and cleanliness without impeding throughput. Unfortunately, many manufacturers are plagued with material handling systems that are simply not adequately specialised for these requirements. Some key conveying problems can have significant impact on product quality and profitability, such as the following:

Inadequate Product Control on Conveyors Causing Defects—Trays may need to be conveyed with clear lids or without lids. Material handling systems not designed specifically for handling ready meal trays can cause product marring, defects, spillage and splashing by not providing adequate product control while on the conveyor system. Conveyor designs that allow the product to come into contact with side rails, or fail to adjust adequately to velocity changes around curves will inevitably introduce unnecessary random product movement on the conveyor, increasing the possibility of damage.

Reduced Cleanliness from Accumulation Conveying—When trays are in an accumulation mode on a belt or chain conveying system, the product may be stopped awaiting infeed for filling or induction into a freezer, but the belts or chain are continuing to run underneath the trays. This continually transfers potential contamination particles such as dirt, dust and lubricants used on these systems.

Top-and Side-Mounted Conveyor Devices Can Impact Product Contamination—Many conveyors that are designed for use with food enable the adaption of product control devices such as product stops, pushers and clamps that can be used to modify the flow of trays. Most conveyors bring these devices in from the side or even over the top, such as would be found on belt conveyors, plastic link conveyors or table-top chain conveyors. Side-mounted devices are limited in their flexibility to control product flow because of their side-only mounting locations, and top-mounted devices are considered even less desirable by manufacturers because of safety and product contamination concerns.

Lane Dividing and Combining at Freezer Entry and Exit Points—Trays entering and exiting the freezers—where transfers occur between ambient-temperature conveyors supplying the freezers, and deep-freeze conveyors providing storage within the freezers—are typically bottleneck points that cause upstream and downstream throughput interruption. Most material-handling systems do not enable adequate lane dividing and combining to facilitate acceptable accumulation.

Misorientation of Trays Exiting the Freezers—Trays moving through the freezer lose their positioning, particularly with spiral conveyors. Most material handling systems do not adequately remedy this condition when trays are exiting the freezers.

Imprecise Infeed Indexing at Packaging Systems—Inaccurate infeed with packaging systems contributes to high defect rates, lessened throughput and increased production costs. This is common particularly with shrink wrapping where mis-wraps can easily occur, jamming the line.

SMARTER TECHNOLOGY FOR CONVEYING OF READY MEAL TRAYS

Three technology developments have directly contributed to enhancing gentle product movement and high-performance conveying of ready meal trays: a) Slip-Torque® roller technology; b) Dynamic Accumulation; and c) SmartFeed®. These were developed by Shuttleworth, a leading designer, manufacturer and integrator of conveyor solutions to solve material handling challenges. These conveyor technologies provide precision capabilities to accumulate, flip, stack, rotate, push, divert, combine and index trays throughout these processes.

SLIP-TORQUE ROLLER TECHNOLOGY, WITH CONTINUOUS DYNAMIC ACCUMULATION

Slip-Torque roller technology utilises individually-powered, stationary rotating roller shafts covered with loose, segmented rollers, which become the conveyor surface. When the tray stops on the surface of the conveyor the segmented rollers beneath also stop, generating low

back-pressure accumulation, minimising product damage. It is the weight of the trays being conveyed, combined with the coefficient of friction between the shafts and the inside diameter of the rollers, that provides the driving force. As the weight of the conveyed tray increases, there is a corresponding increase in the driving force supplied.

Slip-Torque's low line-pressure provided throughout the conveyor, and its continuous-motion Dynamic Accumulation allows for precise placement of trays on the conveyor while it continues to take trays from an upstream line for a period of time, where other conveyors would have stopped well before using conventional conveyor systems. A low back-pressure accumulation buffer absorbs irregularities in the production flow and provides a smooth, even flow on the line.

Servo-controlled guides provide efficient lane changing of incoming trays, eliminating product backlog at the point of entry.

The system allows the same conveyor to be split into multiple, independently-operating lanes if desired. For example, the middle lane can accumulate, while at the same time the right lane and the left lane can both convey, or even run in opposite directions. Each lane acts independently, if needed, but is powered by only one common motor, which also reduces energy usage.

Conveyors with Slip-Torque have the ability to modulate the speed of different sections of the conveyor via a centrally-controlled PLC and HMI. As trays are moving down the line, the rollers at the back end of the conveyor can be moving faster than the ones at the front end of it. The trays can be moving at variable speeds on different sections of the conveyor as dictated by throughput requirements. This controls the tray spacing on the conveyor, keeping the trays separated and equally spaced from each other to minimise product contact and facilitate infeed into the freezer and downstream packaging equipment, such as shrink wrappers and labelling and coding machinery.

The Slip-Torque surface can also be used to minimise product contact while steering trays into desired locations, such as employing rollers with herringbone patterns to orient the trays without the use of guardrails, or setting up a series of sequentially smaller roller heights to direct trays into the centre of the conveyor for singulation and induction into shrink wrappers and case packers, without touching any other conveyor parts. Slip-fit rollers with tapered corners can be used to maintain tray orientation, gently and safely, as it is transported through 45-degree and 90-degree conveyor turns.

Because of the unique features of Slip-Torque rollers, the conveyor system is a safe environment for workers that work near and interact with the trays being carried on the conveyor system. The roller contact surface is designed to stop immediately if a hand is placed on it, thus maintaining a safer working environment.

SMARTFEED

To achieve a much more consistent level of infeed registration with filling and packaging machinery, Shuttleworth developed a series of three automatic infeeds, called SmartFeed. Working in combination with Slip-Torque conveyors, SmartFeed links machine infeed to upstream product flow. It is designed to dynamically accumulate and synchronise the release of products for infeed without stopping the production flow.

SmartFeeds operate by timing the release of product into the flighted infeed with a pneumatic/electric gate, or a servo-controlled variable-speed surface. With a speed-up zone near the discharge end of SmartFeed, one product at a time is placed onto the infeed of the packaging machine. The spacing is very precise, with a tolerance of 0.25 inch to 0.5 inch. SmartFeed is in synchronization with the machine using encoder feedback from it. A sensor identifies each product's location, and then the conveyor will either accelerate or decelerate the product to place it into position on the flighted infeed of the machine.

The downstream machinery and SmartFeed are always talking to each other and reacting to whatever products are moving through the line. When there is a delay with an item, SmartFeed tells the machine that no item is in position, and to slow down or stop. When the next item is in position, SmartFeed tells the machine to start, providing there is accurate indexing of the product. System controls installed upstream regulate the speed of the line throughout, directed by input from SmartFeed. In this way, SmartFeed creates an integrated system monitoring the flow of trays up to and into each filling and packaging system on the tray line.

Several versions of SmartFeed can be integrated for handling filling and packaging of trays:

1. ***Gated SmartFeed and High-Speed Gated SmartFeed***—use a product stop to synchronise the release of trays to the flighted infeed of the wrapper or case packer. The combination of the low-pressure queue area, speed change and the product stop makes for jam-free operation. Gated infeeds operate at rates of 20 to 80 trays per minute. The high-speed infeed can reach rates of 120 trays per minute.

2. ***Multi-Packer SmartFeed***—is designed to release a pattern of multiple trays in time with a flighted or belted infeed. A product stop, combined with an adjustable overhead brake, controls the number of products released.

3. ***Servo-SmartFeed***—combines buffering and indexing into a single-source solution for infeed of trays without the use of devices. This system monitors production flow and delivers this information to the wrapper and case packer for speed modulation. Servo-SmartFeed automatically synchronises to the filling or packaging machine so that the trays are precisely and consistently placed on the infeed of the machine.

GENTLE HANDLING OF FROZEN READY MEALS THROUGH PROCESSING & PACKAGING

Manufacturers of frozen ready meals now have the option of smarter conveyor systems, specifically designed for gentle tray handling and the flexible needs of their manufacturing and packaging lines.

These systems incorporate the necessary automation and product handling devices that enable more productivity, increased versatility, decreased product damage and realisation of a more profitable bottom line. APF