Murray Goulburn Optimizes the Drying Process

Australia's Largest Milk Processor Improves Operational Efficiencies and Increases Yields by Reducing Moisture Variability on its Dryers

Solution

Rockwell Software® Model Predictive Control (MPC) and Optimization Technology

- Continually collects data from each dryer and utilizes predictive models to calculate optimum temperature setpoints for controlling and maintaining the desired moisture level
- Utilizes Predictive Quality – Soft Sensors® to provide in-line, inferential quality measurements and facilitates real-time and frequent control feedback

Results

- Moisture variability levels reduced on average by 52 percent
- Produce average of one ton more of powdered milk product per day across four dryers
- Reduction in energy costs has also contributed to the ROI by 5-10 percent

Background

Powdered milk may not sound appetizing as a substitute for the original, but it's a major ingredient in some of the world's favorite and most nutritious foods – from chocolate to bread to baby food. The process of converting raw cow's milk into dried powder is a sensitive process because the end product needs to retain all the desirable natural properties of the milk – color, flavor, solubility and nutritional value.

The engineers at Murray Goulburn Co-operative are acutely aware of the complexities involved in the milk drying process. Murray Goulburn is Australia's largest milk processor and one of the country's largest exporters of processed foods, turning 35 percent of the nation's milk supply into products sold domestically and internationally. The milk comes from more than 3,000 dairy farms and is processed in nine plants located throughout Victoria and Tasmania.

Since the company was founded in 1950, Murray Goulburn has embraced many new technologies to optimize their processes. Two years ago, they adopted an innovative system to automatically monitor and precisely control the most critical part in the manufacture of powdered milk – the final drying stage.

Challenge

Murray Goulburn's operation near the village of Koroit uses four dryers to process skim milk and whole (full cream) milk into a variety of dairy-based powders. The dryers have steel chambers, standing up to six stories high and 20 meters in diameter. The milk – already gone through an evaporation process to thicken the milk to 50 percent solid matter – is sprayed through the top of the dryer as a fine mist.

Swirling air, which can reach up to 220 ˚C, quickly removes the water from droplets until all that remains is a small particle of milk powder not much larger than a particle of dust. As the droplets fall, the air cools to about 65 ˚C. The powder accumulates on a static fluid bed and then exits onto a series of vibrating fluid beds. Powder from the fluid beds is sifted in a funnel-shaped hopper from which it is conveyed to the packaging area. The tonnage of powder produced varies depending on the size of the tower, the specific type of milk being processed, and the way in which it's processed. Approximately 13 kilograms of whole milk powder or 9 kilograms of skim milk powder can be made from 100 liters of whole milk. The smallest of Murray Goulburn's dryers produces 1.2 tons of powder per hour, while the largest can process 7 tons per hour.

"We knew we needed an automated system to reduce the moisture variability of the powder," said Geoff Rome, automation and utilities engineer at Murray Goulburn.

One of the crucial variables that affects the quality of the powder is its moisture content. Depending on its end use, the powder should contain between approximately 3 to 6 percent moisture. The key to achieving the right moisture level is to control the temperatures of the air entering the tower, the static fluid bed, and the vibrating fluid beds.

In the past, Murray Goulburn operators manually changed these temperature set points to control throughput and moisture content. These decisions were based on the operator's experience utilizing feedback from moisture samples taken once an hour. The company's engineers recognized that once an hour was too long an interval, considering the importance of keeping the moisture balance in the powder. Tests on samples taken every hour showed the moisture would often vary by as much as 0.3%. To create a more consistent product, the temperature setpoints would need to be adjusted automatically based on a predictive model of the dryer.

Maintaining temperature and moisture balance was also important for keeping production at its highest possible level. When the moisture in the air exiting the dryer was too high, the dryer could block and shut down, leading to wasted time, wasted resources and – ultimately – reduced yields.

"We knew we needed an automated system to reduce the moisture variability of the powder," said Geoff Rome, automation and utilities engineer at Murray Goulburn. "Our goal was to find a solution that would help us maintain consistent quality while increasing final product throughput."

Solution

To meet its goals, Murray Goulburn selected the Rockwell Automation Dairy Dryer Solution that is powered by the Rockwell Software Model Predictive Control (MPC) and Optimization technology. The solution continually collects data from each dryer and utilizes predictive models to calculate optimum temperature setpoints for controlling and maintaining the desired moisture level during production.

The solution manages variations in the milk solids concentrate as well as incoming air, humidity and other factors that affect drying efficiency. By reducing moisture variability, the average moisture target can be increased without compromising product quality. This allows higher yields to be produced from the same milk solids, increasing dryer capacity and reducing energy usage per ton of finished product.

Specifically, the system utilizes Predictive Quality – Soft Sensors to provide in-line, inferential quality measurements and facilitates real-time and frequent control feedback. Rather than requiring an operator to manually check the drying process frequently, the system automatically collects data inputs every 15 seconds, resulting in a significant reduction of moisture content variation.

Once every hour, a physical sample of the powder is analyzed with an infrared spectrophotometer to confirm the model. The results are automatically sent back to the modeling system where adjustments are automatically made if necessary.

Results

"The MPC solution from Rockwell Automation performs as well as your best operator, 24 hours a day, seven days a week," Rome said. "The result is the highest quality product – consistently."

With the implementation of the model predictive control solution the moisture variability levels in each dryer were reduced on average by 52 percent – far exceeding Murray Goulburn's expectations of 35 percent. As a result, the company has produced an average of one tonne more of powdered milk product per day across its four dryers.

"Those extra tons of powdered milk out the door made the investment in the Rockwell Automation solution well worth it," Rome said. "Our reduction in energy costs has also contributed to the ROI by five to 10 percent."

Like many other dried milk manufacturers, Murray Goulburn is shifting production toward higher value specialty products that require the finest quality standards, such as protein-enhanced powders. The operating parameters are more narrow and stringent because of strict product specifications. On the drier that produces protein powder, Murray Goulburn has applied early engagement control, helping to achieve optimal thermal efficiency within minutes of the dryer commencing operation.

Real-time visualization in a browser-based interface presents metrics that allow operators and management to monitor the performance measures of production, quality and energy. These dashboards allow current and predicted plant performances to be viewed and managed to realize and sustain the lifetime business value of the dryer solution investment.

The Koroit facility is the second Murray Goulburn site to leverage the Rockwell Automation Dryer Solution. The system is also operating at the Murray Goulburn Leongatha site. The successes achieved at both sites have prompted the company to look into other opportunities to address optimization with its evaporators, dryers and boiler solutions at other facilities.

The results mentioned above are specific to Murray Goulburn's use of Rockwell Automation products and services in conjunction with other products. Specific results may vary for other customers.

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