Christian Cable, Lancaster, UK

GOING WITH THE FLOW

RECENT TECHNOLOGICAL ADVANCES IN CONTINUOUS-PROCESS COOKING AND COOLING HAVE ALLOWED FOOD PROCESSORS TO SIGNIFICANTLY REDUCE THEIR ENERGY AND WATER CONSUMPTION, WHILE ACHIEVING IMPROVED EQUIPMENT AND PROCESS RETURN ON INVESTMENT. BY **JIM MCMAHON**, ZEBRA COMMUNICATIONS

THE cooking and cooling of prepared foods is an area of particular interest for food processors that incorporate pasta, rice, vegetables and dry beans into their food products. Uniformity in cooking and cooling is critical to achieve a refrigerated, frozen or canned meal that will have the desirable texture and taste when it is later reheated for consumption.

The blanched pasta cannot be too stiff or too soft. The fettuccine, linguine, tagliatelle and spaghetti cannot be stuck together or damaged. The cooked rice should keep its texture, have the right amount of free starch or stickiness and maintain its kernel integrity. Dry beans should not be bursting or split. And vegetables should have the desired firmness and consistency. Without a highly effective cooking and cooling capability, these products cannot be obtained with a high degree of uniformity.

Along with improving the precision of cooking and cooling parameters, food processors are always looking for ways to reduce process costs, and, more recently, achieve a higher level of sustainability in their operations.

There are many processes in food manufacturing that can be addressed to reduce operating costs, while at the same time improving sustainability. One of the most critically important objectives to achieving this is reducing process energy and water consumption.

Implementing energy- and water-efficient practices and technologies should be a senior priority at system levels in food manufacturing plants. With the continual increase in energy and water costs, optimising energy and water usage in food processing has never been a stronger issue.

Embracing these sustainability initiatives is the continuous-process cooking and cooling method for pasta, rice and vegetables. This process has experienced continual improvements to its technology over the past four decades in the reduction of energy consumption, through improved system designs and streamlined automation. Recent technological advances in continuous-process cooking and cooling have made significant improvements in reaching critical energy and water efficiency levels.

CONTINUOUS-PROCESS COOKING & COOLING

Continuous-process cooking and cooling evolved from the batch method, which has been a standard in commercial cooking and cooling systems. However, the batch method has its drawbacks.

It is somewhat limited in maintaining precise temperature and time parameters of the pasta, rice or vegetable food products in the cooking and cooling process. The batch process is also limited in its agitation capability to keep these products separated during the cook and chill processes, which facilitates consistent temperatures in the product.

The first generation of continuous-process cooking/cooling systems used conveyors to move food products through the processes in series. For many years, water-spray conveyor systems were the standard for cooking and cooling food products, but these systems have their drawbacks.

Cookers and coolers are only as good as their ability to precisely control the product's exposure to time and temperature parameters throughout the processes. Conveyor-based systems, however, are prone to variable production rates, which introduces variations in product temperature resulting in inconsistent product quality.

Lacking uniform water spray coverage of the product, and adequate agitation to keep pasta, rice and vegetables separated during the cook and chill cycles, products tend to be unevenly cooked and the cooling process insufficient to uniformly halt cooking.

Rotary drum cooker/coolers have significantly improved the processing of pasta and rice.

These conveyor-based systems have been superseded by rotary drum continuous-process cooker/coolers, which utilise an auger method to move food products through an enclosed, water-filled drum.

Considered the industry standard for continuous-process cook and chill methods, rotary drum cooker/coolers have significantly improved the processing of pasta, rice and vegetables.

These improvements have ensured more uniform processes and allowed cookers and coolers to handle even higher throughputs. Step-blanching, for example, enables incremental temperature increases to be made throughout the process.

CONTROL SYSTEMS

Gentle mechanical agitation can be imparted

PLCs enable uniform cooking temperatures and control volume of water flow, achieving a consistent end process.

to the food products as they progress through the cook and chill processes. A system called Hydro-Flow applies a combination of air and water injection which physically and buoyantly supports heavier loads, more evenly distributing food products in cookers and coolers.

Controls automation integrated into rotary drum continuous-process cooker and cooler systems has largely made these improvements possible. Their programmable logic controllers (PLCs) provide precise automated control of process functions, including recipe management, and enable uniform cooking temperatures and control of water flow, achieving a totally consistent end process.

Rool Paap, Rotterham, the Netherlands

THE LATEST TECHNOLOGY IN CONTINUOUS-PROCESS ROTARY DRUM COOKING CAPTURE AND REUSE HEAT ENERGY.

These control systems minimise the time required to perform complex tasks and increase efficiency in cooking and cooling process operations. They reduce operator error and process cycle times, enable improvement in product quality and consistency, and increase production throughput and equipment return on investment (ROI).

The benefits from these automated process technologies have also minimised energy and water consumption. Compared to batch systems and conveyor-based cooker/coolers, the latest improvements in rotary drum continuous-process cooker/coolers enables them to process the same volume of pasta, rice or vegetables in less time, using significantly less energy to heat the water required for the processes.

Monitoring energy and water usage, and managing process systems in these rotary drum cookers and coolers has played an important role supporting sustainability efforts in food processing plants.

RECAPTURING HEAT & WATER

With conventional rotary drum continuous-process cooking, the cooker is filled with ambient-temperature (approximately 65 deg F) water and heated to 200 to 205 deg F. In the processing of pasta, rice or vegetables, the water needs to be continually heated to compensate for the constant addition of ambient-temperature product. This requires energy.

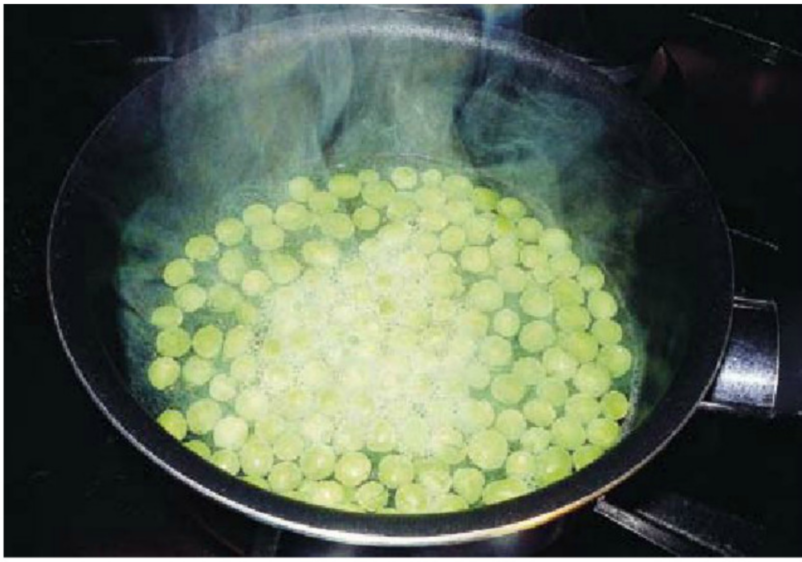
Additionally, in the processing of pasta and rice, because water is absorbed into the products during cooking, ambient-temperature make-up water needs to be continually added into the rotary drum. This adds to the heat load requirements of the cooker. This also requires energy.

During a process run of pasta, rice or starchy vegetables, which may continue for 20 continuous hours, as much as 10 gallons of water can be overflowed per minute to reduce the build-up of starch in the water. This means an equal amount of make-up water needs to be added. The volume of overflow and make-up water varies depending on the size of the cooker, and the type and volume of pasta, rice or vegetables being run.

The overflow water is discarded as wastewater, and is taking the 200 to 205 deg F heat energy out along with it. For every gallon that comes out of the cooker at 200 to 205 deg F as overflow, a gallon of make-up tap water at approximately 65 deg F needs to be added. The cooker, then, has to heat that water back up to 200 to 205 deg F to continue the cook process. This requires energy.

In essence, not only is the overflow heat energy from the cooker being wasted, new energy now has to be added to reheat the water in the cooker to 200 to 205 deg F.

The latest technology in continuous-process



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rotary drum cooking is now capturing and reusing the heat from the 200 to 205 deg F overflow water. Leaving the cooker, the overflow water, instead of being put down the drain, is moved to an adjacent storage tank where it is pumped through a heat exchanger. The heat is transferred from the hot overflow water to a reservoir of ambient-temperature make-up water before it is put into the cooker.

With this process, the make-up water can reach 125 deg F, considerably higher than the approximately 65 deg F tap-originated make-up water used in all prior continuous-process cooker systems. This significantly reduces the heating load requirements of the cooker.

Rotary drum cooking significantly reduces the heating load requirements of the cooker.

A sizable difference in energy savings can be realised when heating water to 200 deg F from a starting point of 125 deg F, rather than from 65 deg F.

Additionally, the starch laden overflow water, which has previously been discarded, is then screened to remove the particulates and reused as make-up water to compensate for product absorption, providing significant water savings.

ENERGY RECUPERATION

In rotary drum cooking and cooling, the pasta, rice or vegetables come out of the cooker at 200 to 205 deg F. The product then immediately goes into a chiller where it is cooled in 35 to 40 deg F water. Initially, the water put into the chiller is tap water with a temperature of about 65 deg F. To bring the chiller's water temperature down to the 35 to 40 deg F range needed for cooling product, energy has to be expended.

As hot food products are released into the chiller, the water has to be continually cooled to take the heat out of the product and bring its temperature down to a safe 40 deg F range quickly, to reduce the potential of bacterial growth. This requires energy.

Bacteria predominantly grow in an environment that is between 40 deg and 140 deg F. During the cooking process, raw ingredients are brought up past 140 deg F as quickly as possible to the final cooking temperature, thus minimising the time that food products can be influenced by bacterial growth. The same is true on the other end of the process line, with the cooling of the product—reducing its temperature as quickly as possible to below 40 deg F is essential.

The energy usage in this cook and cool process has been considerably improved upon with the addition of a mid-process quench step, adding a small reservoir between the cooker and the cooler.

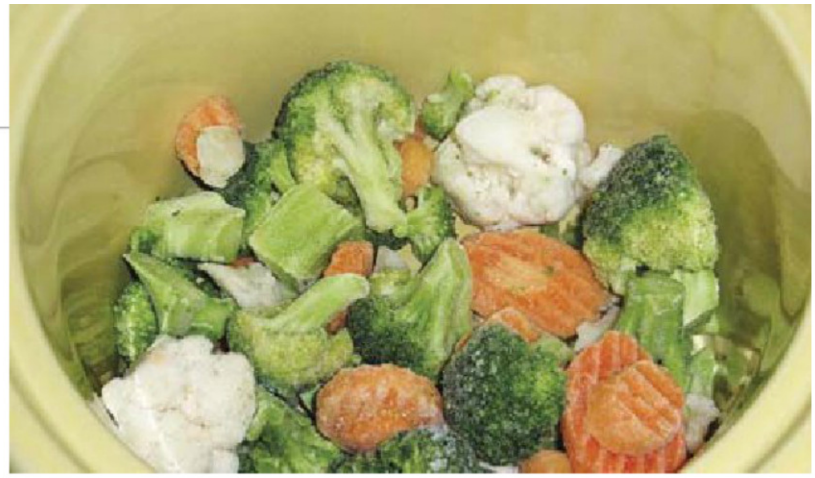
Instead of moving the product directly from the 200 to 205 deg F water temperature of the cooker and into the 35 to 40 deg F chiller water, a mid-process quench cycle with unheated ambient-temperature tap water (65 deg F) can capture much of the product's heat before it enters the primary chill cycle. Since the quench tap water is not preheated, it requires no energy input.

Quenching reduces the temperature of the pasta, rice or vegetables down to 110 to 120 deg F, capturing 45 to 50 percent of the cooked product's heat energy in the quench water. The 110 to 120 deg F water in the quench can then be used in the cooker for make-up water to re-hydrate the product, instead of bringing in the usual 65 deg F tap water to reach the 200 to 205 deg F temperature cooking range. This sizably reduces the energy draw normally needed to heat the cooker water.

The quench then releases the product into the chiller, which now only has to bring the product temperature down 70 to 80 deg F to reach the targeted 40 deg F, instead of needing to bring the temperature down 160 to 165 deg F if the quench cycle was not in place. The energy savings in the chiller from the reduced refrigeration load is significant.

The quench system, called Easy-Flow, developed by Lyco Manufacturing, maintains 100 percent uniform product cooling with less than one percent product damage. Rice, most varieties of pasta, and select vegetables can be cooled in the quench to 110 to 120 deg F before entering the chilled water cooler.

The system uses a patented plenum technology to achieve its high-speed cooling without damaging the product. The pasta, rice or vegetables are pulled through the cooling plenum at the bottom of the tank by Venturi effect, which increases the velocity of the fluid without pump impeller contact.



Joel Kramer

The Venturi effect creates a pressure differential that pulls the water and product through at a high speed with the capability of moving 300 gallons of water and product through the plenum per minute.

REDUCED ENERGY & WATER CONSUMPTION

These recent technological advances in continuous-process cooking and cooling have allowed food processors to significantly reduce their energy and water consumption, while achieving improved equipment and process return on investment (ROI). Compared to conventional rotary drum continuous-process cooking, recapturing heat and water from cooker overflow and quench systems can result in considerable savings.

When recapturing heat and water from cooker overflow, British thermal units (BTUs) can be reduced by 60 percent, kilowatt hours (kWh) can be reduced by 72 percent and water usage can be reduced by 25 percent.

With the quench system in place, for a continuous-process rotary tank cooker, BTUs and kilowatt hours can be reduced by 35 percent compared to an identical rotary tank cooker without the quench system.

For the chiller under the same conditions, with the quench system in place, BTUs, tonnes of cooling required per hour, and kWh can be reduced by 41 percent.

EMBRACING SUSTAINABILITY

Waste reduction, resource and energy management, improved process controls and throughput efficiency are key factors that have influenced the acceptance of the latest continuous process cooking and cooling systems. These are critical functions for achieving sustainable practices in the processing of food products. These latest developments save energy, increase productivity, and reduce environmental impacts.

Advanced continuous process cooking and cooling of pasta, rice and vegetables has emerged as an innovation in sustainable technology within the food processing industry. As government agencies and food manufacturers steadily, but surely, embrace the sustainability initiative, continuous-process technology in food processing will continue to occupy a prominent position in the evolution of sustainable processing. APFI

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