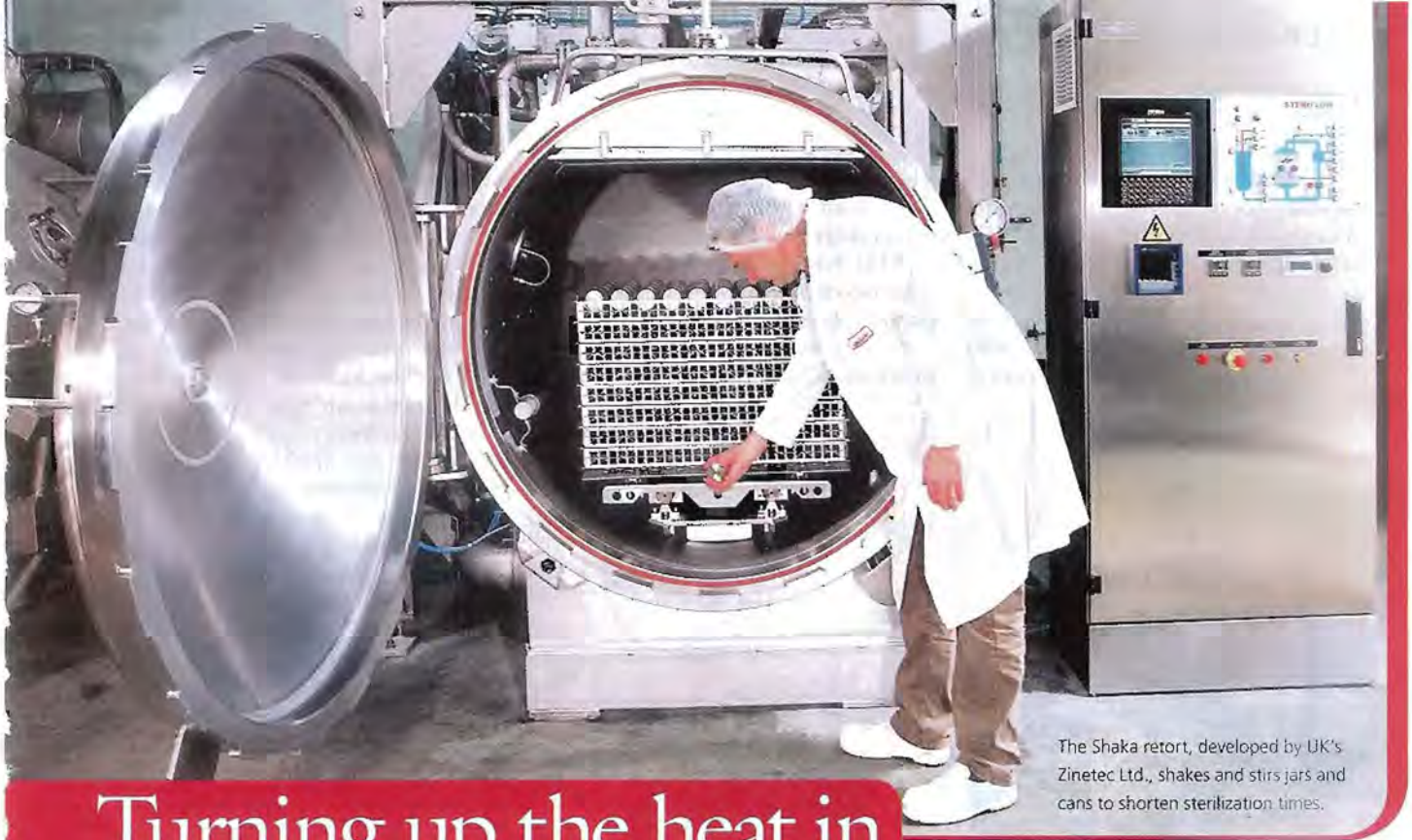

The Shaka retort, developed by UK's Zinetec Ltd., shakes and stirs jars and cans to shorten sterilization times.

Turning up the heat in thermal processing

Energy costs are forcing innovations on the traditional cooking processes.

By Mike Deharnich, Plant Operations Editor

WHO SAID PROCESSING INNOVATION IS DEAD ... or even slumbering? Concerns over energy costs and greenhouse gas emissions are motivating improvements to the food industry's ubiquitous thermal processing systems. From creative heat-transfer systems and hybrid – and combo – heating processes to whittle at process times, innovation is finding its way into more of today's processing equipment.

"With the rising cost of energy, processors are looking for any way they can increase the thermal efficiency of their processing systems, and often this involves simply using otherwise wasted energy," says Don Giles, director of sales for Heat and Control's Processing Systems Div. (www.heatandcontrol.com/processing.asp), Hayward, Calif.

Exhaust heat from heat exchangers, fryers and ovens can be tapped to pre-heat cooking oil or burner combustion air for energy efficiency increases of 3-12 percent. "In some instances," notes Giles, "the increase in thermal efficiency also can result in higher finished product output if your system is heat input limited."

Indeed, energy is the big driver in thermal equipment advances. The more heat you can save or recycle, the happier the processor. Same goes for economical heat generation. Thus, heat transfer systems and processing equipment and lines that incorporate multiple heating methods to cut process times and costs are headline developments.

Richard Magoon was swimming under water during a vacation in El Salvador, pondering the refractance in a plastic bag on the surface when the idea hit him.

"I could see the object in the bag, but the rest was indistinguishable," recalls Magoon. "That was when I first saw the refractance window, the refractance of the air/water interface."

If you have water on both sides of a transparent medium, you open a window for a ray to pass through that surface, Magoon explains. Therein lies the principle behind the now patented drying technology of his company, MCD Technologies Inc. (www.mcdtechnologiesinc.com), Tacoma, Wash.

The drying process he pioneered directs infrared radiation (or "ray-form energy") at the speed of light directly into a product or liquid slurry. Evaporation is the result of infrared and conducted heat energy. Adding water on both sides of a transparent medium opens a window in that material for the ray to pass through the surface. "By doing that, you can be very efficient and produce a higher quality of product," he explains.

Applicable to the drying of fruits, vegetables, fish, meats, cocoa, coffee and many more products, the process is highly efficient and enables a processor to dry product at temperatures as low as 140°F. The result is superior color retention, nutrient quality and aroma. "The quality compares to that of freeze-dried foods. But it dries at low temperatures, rarely over 160°F, and often not even near that," he says.

Capital and operational costs are the big story. The equipment costs roughly one-third as much as freeze-drying equipment; energy used is one-third as well.

"We have a very energy-efficient and low-cost piece of machinery that provides an extremely high quality product," says Karin Magoon, MCD president, noting the system's 96-99 percent efficiency in energy transfer through the refractance window. It requires only 1,200-1,400 BTUs per pound of water evaporated. The best freeze-dry system performance takes about 3,400 BTUs. Air and spray dryers range from 4,000 to 5,000.

"The Navy uses a dried egg product made by one of our customers. It's indistinguishable from fresh scrambled," she says.

So far, the technology has been used to dry algaes (for biodiesel fuel and nutraceuticals) and fish, among other applications. According to Karin Magoon, the USDA has funded a project using one of the MCD units to protect color and anthocyanins (antioxidant phytonutrients) in drying Alaskan blueberries. A processor in Newfoundland also uses it for berry drying. But the Magoons insist the process can be used in any type of product in liquid or slurry form.

Shaking up retorting

The history of thermal processing of prepared foods has been largely incremental, says John Emanuel, chairman of London-based Utek Europe Ltd. But the Shaka process, (www.shakaprocess.com) developed by Utek's client, Zinetec Ltd. of the UK, can sterilize a variety of products in 6-12 mins. (heat, sterilize and cool). Conventional retort processes typically take an hour or more. The Shaka system provides the product protection and shelf-stability of traditional canned, bottled or pouch-packed products.

The radically diminished cook times are achieved by the vigorous mixing of the food contents, enabling rapid heat transfer through the containers and through the basket holding them.

Conventional retort processes are time- and energy-intensive. Food near the container walls sterilizes relatively quickly, but heat penetration to the interior of the can may take hours. The container will not be sterile until every microorganism in the middle is destroyed. The extended sterilizing time of food within the container accounts for the "overcooked" flavor of many canned foods.

The Shaka process stirs the contents in the package in a manner that allows heat to penetrate to the center of the container and sterilize the contents very quickly.

"The equipment looks like an ordinary retort, a pressure vessel with a door," says

NOTE TO QUALITY CONTROL

Pressure to reduce energy costs is making hybrid and alternative thermal processing methods attractive. Watch carefully that product run on any new system is cooked thoroughly and is safe to eat, of course.

The addition of microwave systems, which may save on cooking time and energy consumption, may add a heating variable particularly worth watching.

Emanuel. "But there's a motor and an actuator going through a port in the pressure vessel. It shakes the basket holding the containers about 150 times per minute. The process speeds up tremendously and eliminates the overcooking found with a normal retort."

"At first I thought our biggest advantage was energy – taking minutes instead of hours to sterilize and cook product," says Emanuel. "But the real advantage is in food quality. The result is product closer to freshly cooked or chilled food." But with very long shelf life at ambient conditions.

Three leading retort manufacturing companies – including Allpax Products in Covington, La., and Steriflow in France – make Shaka process retorts under license from Zinetec Ltd. Utek Europe is advising Zinetec on commercialization.

The Shaka process is not suitable for solids, according to Emanuel. But it shines when applied to soups, sauces, baby food, soya-based drinks, dips, cheese sauces, chopped vegetables, milk-based drinks and pet foods. Product has a long shelf life at ambient temperatures. Like the usual array of heat processed foods, product will last for years.

Heat and Control's HeatWave system conveys product through curtains of hot oil, claiming energy, cost and quality advantages over conventional "submerge-in-oil" frying.

Combo systems and energy improvements

Fast-food operators aren't the only ones asking if you'd like "a combo." More and more of today's processors are incorporating multiple types of thermal processing equipment into a processing system. Branders, searers, ovens and fryers are often combined to deliver custom products having unique taste and consumer appeal. Some hybrid heating/cooking systems also use continuous microwave ovens to increase throughput and garner significant energy savings.

"We're seeing more add-on components added to the front, middle or back of a system," says Heat and Control's Giles. "Processing systems for prepared foods such as boneless breaded chicken breasts traditionally have been simple sequences of applying batter and breading, frying and finishing in an oven. Today it's more

MCD Technologies' "refractance window" technology directs infrared radiation into a product or liquid slurry for speedy evaporative drying.

common for processors to also use steam chambers, infrared ovens and other devices to more efficiently transfer heat the product, improve the energy efficiency of the process and increase output capacity."

That microwave addition may boost yield 3-15 percent and increase capacity 15-50 percent. "A 10 percent increase in throughput can be very efficient," says Giles. "The microwave might be 20 feet long and cost a quarter million dollars, but that can be peanuts in the scope of things."

Oven-microwave combos can improve the efficiency of poultry products, nuggets, sausage toppings, bacon bits and strips, patties, meatballs, hot pockets, potato products and snacks.

A "totally different frying concept" called HeatWave from Heat and Control claims energy, cost and quality advantages over conventional "submerge-in-oil" frying. The system conveys product through curtains of hot oil that descend from overhead weirs. The system was developed for meat, poultry and seafood but also works on nuts and other snack products.

The Stein GCO-II GyroCompact spiral oven from FMC FoodTech incorporates multiple cooking processes to produce more moist and tender meat products.

The oven consists of two distinct cooking processes: an initial phase using steam condensation and a convection phase of superheated steam-air mixture for quick cooking. The combination helps maintain uniformity and quality across the belt width. Timing the right mode of heat transfer at the appropriate time in the cooking process delivers products that are more moist and tender with better appearance and flavor as well.

The company offers the system as an alternative to conventional microwave ovens to bacon processors, claiming higher yields and throughput, better steam containment, improved mesh belt design and enhanced vertical air flow.

"Average yield is the primary measurement, not temperature, in bacon processing," says Ramesh Gunawardena, manager of technology and process development for Chicago-based FMC FoodTech (www.fmcfoodtech.com). "The variability in temperature control leads to inconsistent quality. The superior cross-belt temperature control of the GCO-II allows production at a lower standard temperature deviation. That produces more consistent and superior overall product quality."

A supplementary impingement section gives processors more flexibility and higher output with significantly lower maintenance costs.

MORE ON THE WEB

FMC FoodTech has seven Food Processing and Technology Centers that allow processors to test new technologies and equipment, refine applications or experiment with new ones. They're in Madera, Calif.; Lakeland, Fla.; Sandusky, Ohio; St. Niklaas, Belgium; Helsingborg, Sweden; and Araraquara, Brazil. Check them out at www.FoodProcessing.com/FMClabs.

Heat and Control has a technical library with technical articles, brochures and equipment videos, as well as a downloaded unit conversion utility, which converts everything from international standards to velocity, mass, force, pressure, density, temperatures, fuel consumption, etc. See: www.FoodProcessing.com/heatcontrol_library.