Stainless steel tanks and kettles are synonymous with dairy manufacturing, but the long-term trend is toward continuous processes that don’t require the tools of batch.

By Kevin T. Higgins, Managing Editor

The Singh family calls it ice cream, but Kaurina’s Kulfi is at best a distant cousin to the frozen, aerated treat most Americans recognize as an ice cream bar.

Introduced to the Indian subcontinent in the 16th Century, kulfi consists of corn starch, sugar, natural flavors such as mango pulp and pistachio, and milk that has been boiled down and caramelized. The other ingredients then are blended, and the compound is poured into molds and frozen, resulting in a novelty that is “basically a condensed version of ice cream with almost universal appeal,” suggests Aman Singh, executive vice president of Dallas-based Kaurina’s (www.kaurinas.com).

Kaurina’s is a 13-year-old commercial enterprise that is slowly spreading to the East and West coasts and winning an audience outside the Indian ethnic niche. An electrical engineer, Singh carefully treads the line between automated production and his family’s secret recipe for kulfi.

“No one knows how to cook the milk to the right consistency except the members of our family,” he says. The process has evolved from stockpots that were stirred by hand to 80-gallon kettles with agitators. Evaporators that could more efficiently remove the water would be a step up; so would a pump to transfer the blend to brine tanks for freezing.

Until demand can justify automation, Singh must rationalize the process as a guarantee of quality, a hedge against bowdlerization. In that sense, he is like every other dairy processor that clings to batch processes. Continuous options are proliferating in dairy, aided and abetted by sanitary rotor stator assemblies that provide an option to stirred vessels and static mixers.

Adding dry ingredients to a fluid stream is becoming common. Some yogurt recipes used at Commonwealth Dairy (www.common-
wealthdairy.com) in Brattleboro, Vt., require the introduction of powders before milk moves to fermentation tanks. In-tank mixing is the traditional approach, but the two-year-old dairy is not bound by tradition. Instead, Commonwealth uses a low-shear blending system powered by a 20hp motor and outfitted with a special impeller to mix powders in line. “It’s very expensive,” production manager Berthold Gruber says of the system, “but essentially it’s nothing but a pump.”

Pump specialists beg to differ. Finite particles are a challenge for mechanical seals, and when ice cream processors mix chocolate, shearing can produce a glassy substrate that can bind and break a pump, according to Wallace Wittkoff, global director of the hygienic segment of Pump Solutions Group (PSG) (www.pumpsg.com), Redlands, Calif.

If those fine particles are to be blended in line, there must be sufficient clearance between the rotor and stator to avoid binding and shear while minimizing pump slip. One solution is PSG’s Mouvex, a positive displacement pump featuring “eccentric disk technology” that self-adjusts pump clearance with a spring-based automatic clutch. The result is low shear and minimal slip.

Progressive cavity pumps can deliver similar performance, Wittkoff concedes, but they require control loops for back pressure control and process stabilization. “It’s difficult to do and very inflexible,” he says, whereas the Mouvex unit only requires one control loop.

In-line mixing and formulation of dairy-based products “seemed like a no-brainer to do in the ’90s” as a way to speed production and eliminate tanks, agitators and other elements of batch processing, recalls Wittkoff. But technical barriers quickly emerged. “Most pumps just don’t have a tight enough control band,” he notes, “so you can’t settle down at the right ratio to produce consistent product.”

An exception is Mouvex, manufactured in France and acquired by PSG a dozen years ago. The pump is widely used in Europe by Nestle and others to produce yogurt and other sensitive products. More recently, Nestle’s Edy’s plant in Fort Wayne, Ind., incorporated it into chocolate ice cream production.

Originally a Borden’s facility, the 28-year-old Edy’s plant has a throughput of 50 million cases a year, according to plant manager Sheila Brojeck. Almost 300 SKUs are produced, although mainstays like vanilla, chocolate and vanilla-chocolate blend are being filled daily. Continuous mixing is the rule, with a 750-gal. staging vessel for vanilla paired with two chocolate vessels with an equivalent amount of ice cream. A WCB pump undergoes monthly calibration to ensure that equal amounts are drawn from the complementary vats for 50-50 flow to a filler outputting 75-80 cartons a minute.

Newer mixing and blending technology from WCB parent SPX includes the APV Cavitator, a system introduced at the 2011 Process Expo show. The system combines an APV centrifugal pump with a controlled cavitation chamber that is particularly adept at mixing and heating sensitive proteins such as whey protein concentrate and other dairy fractions.

“This latest technology uses a rotor with radial holes spinning in a...
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liquid chamber,” explains Bent Oestergaard, director-global marketing, food & beverage for SPX Flow Technology (www.spxft.com), Charlotte, N.C. “The spinning action generates internal liquid frictions, and the holes generate hydrodynamic cavitation, which creates efficient, high-shear, microscopic mixing.” Because heat transfer occurs within the cavitation zone, no surface burn-on or fouling occurs.

One of the largest installed bases for blending dairy and other foods belongs to the Breddo Likwifier, an industry workhorse since 1958. While it exemplifies batch, the blender undergoes continuous improvement to meet the industry’s shifting hydration needs, according to Bill Wade, sales manager of the Kansas City, Mo.-based division of Caravan Ingredients Co. (www.breddo.com).

“There is so much going on with drinkable yogurts and other healthy drinks that require different blending characteristics,” he points out. Impeller refinements that increase shear and flow rates in existing tanks are a particular focus of the company. “By changing the impeller, we can change the characteristics of the blender,” adds Wade.

Data-driven improvements
Continuous improvement is a focus at Edy’s-Fort Wayne, with the data-driven DMAIC (define, measure, analyze, improve, control) cycle serving as the staff’s touchstone. Those efforts will be enhanced with a conversion to SAP, which will help the facility implement an overall equipment effectiveness (OEE) initiative, according to Brojek.

Brewster Dairy is another dairy that recently updated its ERP system, although Brewster’s choice was Adage from Infor, along with the supplier’s Ion middleware and EAM package. “We were the first company to go live on ION,” boasts Dale Brittan, chief information officer at the Brewster, Ohio-based cheese company (www.brewstercheese.com). Six months of testing preceded the software upgrade at Brewster’s three facilities two years ago. “I was convinced when we turned it on it would do well,” says Brittan. Still, “much to my surprise, the implementation only took four days.”

An enhanced asset management system was part of a recent software upgrade at Brewster Dairy, an Ohio-based cheese manufacturer with additional plants in Illinois and Idaho. Photo: Infor

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As with many mid-sized dairies, Brewster has followed an acquisition-fueled growth path, beginning with a cheese plant in Stockton, Ill., in 1998 and a former Kraft facility in Rupert, Idaho, in 2007. The Ohio and Illinois plants produce Swiss cheese, while Idaho supplies cheese used for baking crackers.

All three had ERP and asset management systems, none of which were integrated with the other plants or within the same facility. Result: lots of re-keying of data and no fix on what machinery or parts were on hand across the network.

The Ohio facility was using MP2, a Windows-based computerized maintenance management system (CMMS) introduced 16 years ago by Datastream Systems Inc. Datastream was acquired by Infor in 2006, and MP2 gave way to EAM, shorthand for enterprise asset management. Shifting from CMMS to asset management isn’t simply semantics, according to Kevin Price, EAM product manager for New York-based Infor (www.infor.com).

“MP2 just doesn’t have the oomph to get off a client-server configuration,” says Price, who helped launch MP2. “People dismissed CMMS, saying, ‘It just tracks work-order transactions, why not use a spreadsheet?’ But today’s IT infrastructure requires a lot more integration. You have to be able to support every asset in the company, including people.”

Brewster has used EAM to transfer unused equipment at one plant to another facility that needed it and to get a better handle on what replacement parts were in which parts bin, but those are crawl-before-you-walk improvements. As the dairy builds performance data, it will begin to evolve toward energy demand management, the fourth tier in the maintenance hierarchy.

As Price explains, the progression is reactive (run to failure), preventive (scheduled maintenance), predictive and, finally, consumptive. These are the energy related costs that account for 60 percent of the total cost of ownership over the useful life of a machine.

“The No. 1 cost to an organization is always going to be machine downtime, but why is there downtime?” Price rhetorically asks. He likens reports on energy-consumption trends to an automobile that drops from 26 mpg to 13 mpg: If the car’s owner is aware, he won’t delay ordering a diagnostic test, before a tow truck is needed.

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“Reliability engineers are trying to extract this kind of information themselves so they can incorporate it in machine RFPs,” says Price. “Looking at OEE is great, but consumptive data let you know how you are consuming energy and help avoid downtime while showing you how you can run equipment for less.”

Brewster hasn’t reached that stage yet, but it is building the foundation. More accurate parts inventories and maintenance tracking has probably improved machine uptime, although Brittan can’t quantify the amount. But he knows the needed cultural changes are occurring, and better documentation is paying off with smoother third-party audits.

“I’ve become such a big EAM fan, I’m using it to map corporate IT assets, such as IP addresses and automation hardware,” not just work orders and parts, he says.

**Pasteurize with light, not heat**

The Pasteurized Milk Ordinance (PMO) has helped dairies maintain the gold standard in hygienic procedures and sanitary design in food processing, and the PMO underpins many of the thermal processes and related tanks in conventional purification. But a 2009 change in the PMO created a new option for disinfecting and pasteurizing process water from municipal sources, and dairies are slowly embracing the change.

UV disinfection has a checkered past, not only in dairies but other food production environments, with some in-house engineered systems doing as good a job at adding shattered glass to processes as they did at removing microbes. In 2005, Atlantium Technologies (www.atlantium.com), Beit Shemesh, Israel, began working with FDA to revise outdated rules governing UV applications to bring them in line with contemporary scientific understanding. The collaboration ultimately led to the PMO revision.

Atlantium undertook the project to provide all UV systems with a science-based validation protocol, according to Phyllis Posy, Atlantium’s vice president of regulatory affairs. Atlantium employs medium pressure, high intensity UV lamps that emit polychromatic wavelengths to destroy specific bacteria and viruses that often lurk in municipal water. This is in contrast to the low pressure, long lamps that emit a single wavelength often are used.

More importantly, the system has controls that adjust wavelengths and their intensity based on feedback from sensors that monitor mass flow and water turbidity, producing real-time documentation on performance. Additionally, the lamps are isolated from fluid flow, eliminating the possibility that a shattered lamp will contaminate the fluid stream.

“Without documentation and accountability, people got used to paying bupkis for UV pasteurization, and that is what they got,” says Posy. “When the systems worked, it was happenstance. We’ve had to adjust expectations not only on the performance side but also on the cost side.”

Existing dairies already have pasteurization and storage tanks for process water, and currently low prices for natural gas extend the ROI from switching to UV, she concedes. However, one extended shelflife (ESL) milk processor determined “the aggravation factor from downtime when pasteurized water demand exceeded supply was enough to make the switch,” says Posy. Greenfield facilities, on the other hand, are not invested in storage tanks. When Commonwealth Dairy (www.commonwealthdairy.com) commenced production in April 2011, UV pasteurized its push water.

According to Daniel Frommel, maintenance manager at the Brattleboro, Vt., plant, the cost differential between multiple tanks and energy inputs vs. periodic replacement of UV lamps made the decision an easy call.

“The Atlantium system is the only one we’re aware of that is an option under the PMO,” he says.

Flavor changeovers require the introduction of pasteurized water to push the current yogurt variety in the line to the filler before the new yogurt can be filled. The UV water does the job while maintaining sterility in the line, reducing product waste and avoiding a CIP cycle.

The economics strongly favored UV. Plus, Frommel likes the freedom of movement in a dairy not cluttered with tanks and storage bins.