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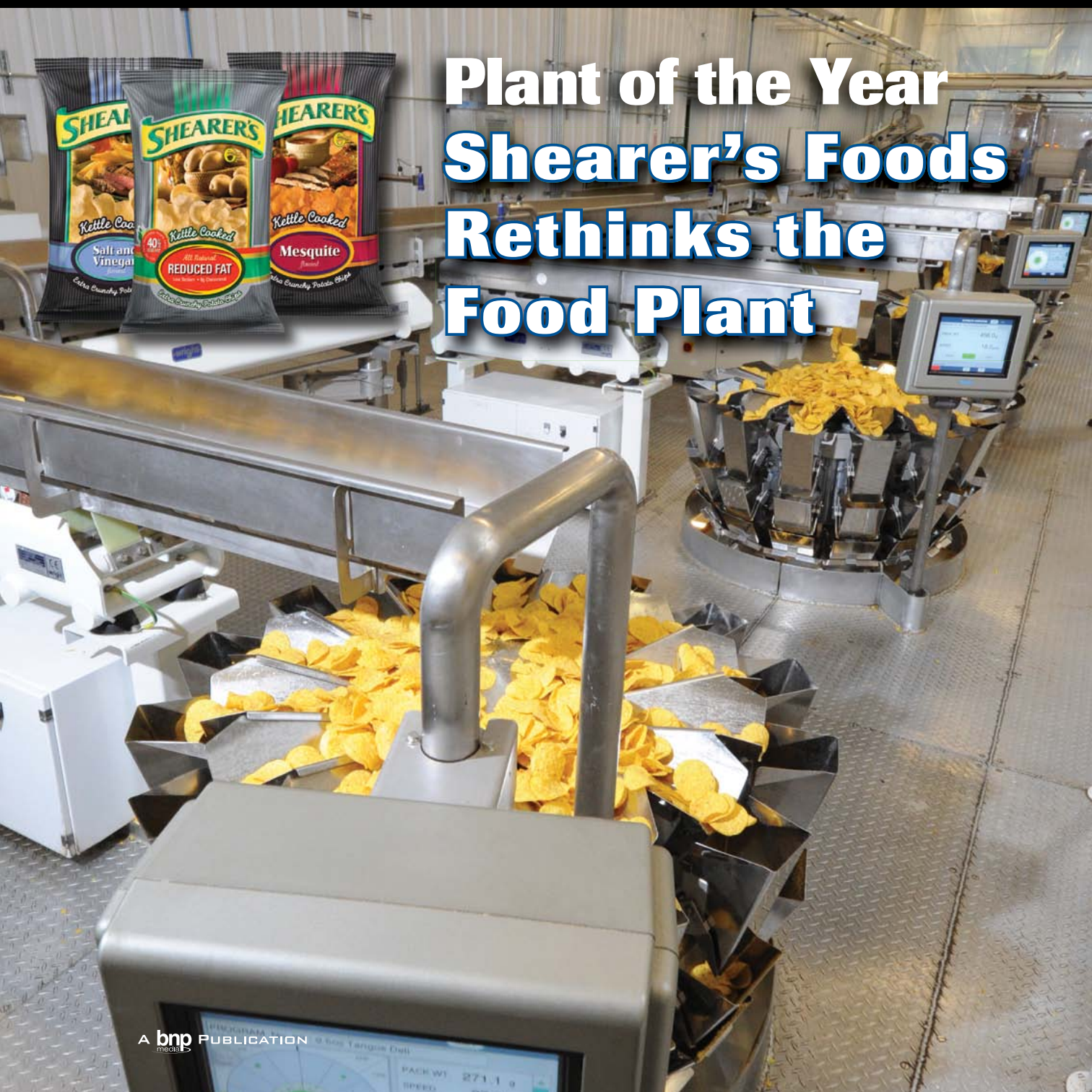
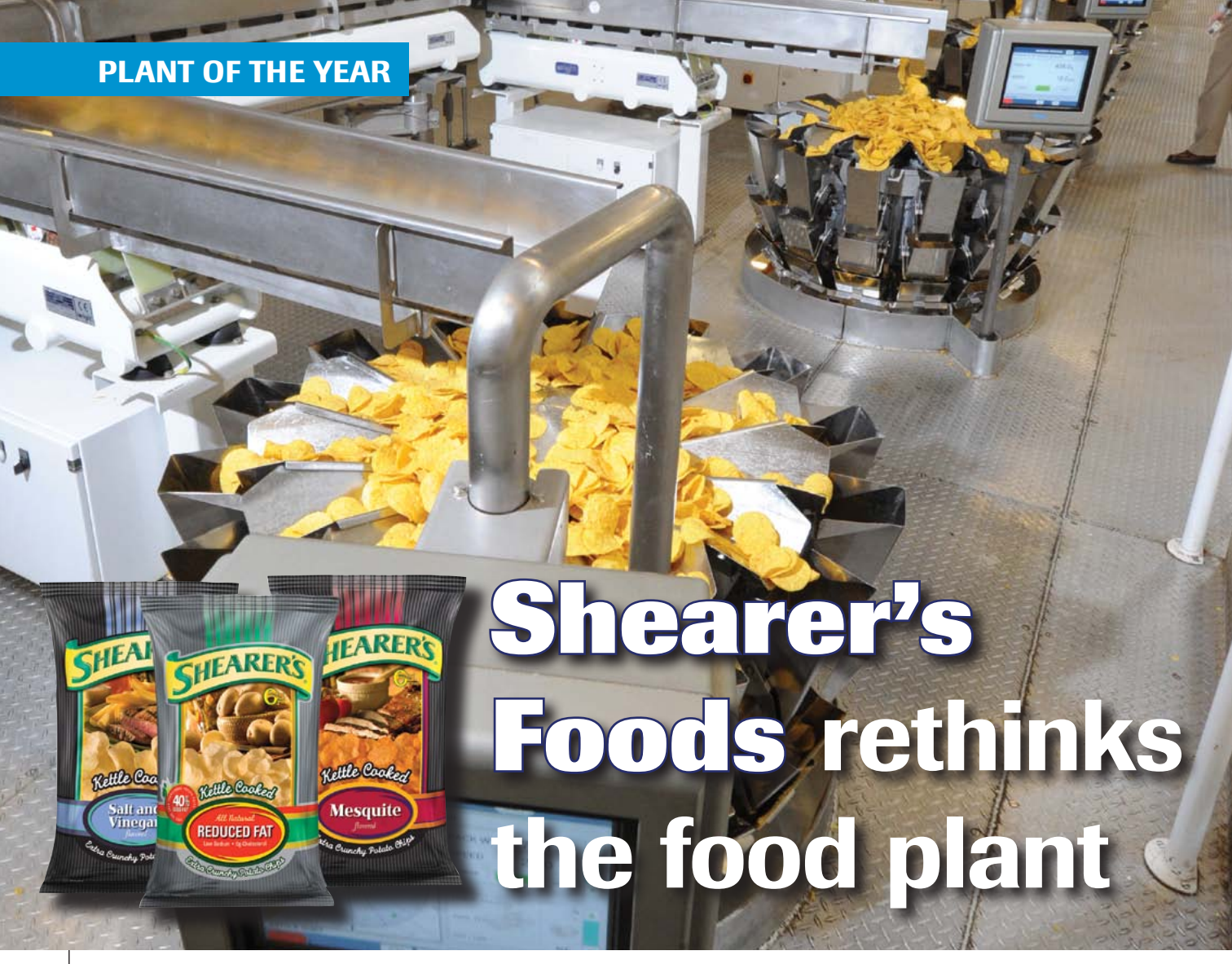


Plant of the Year
Shearer's Foods Rethinks the Food Plant

A bnp media PUBLICATION



Shearer's Foods rethinks the food plant

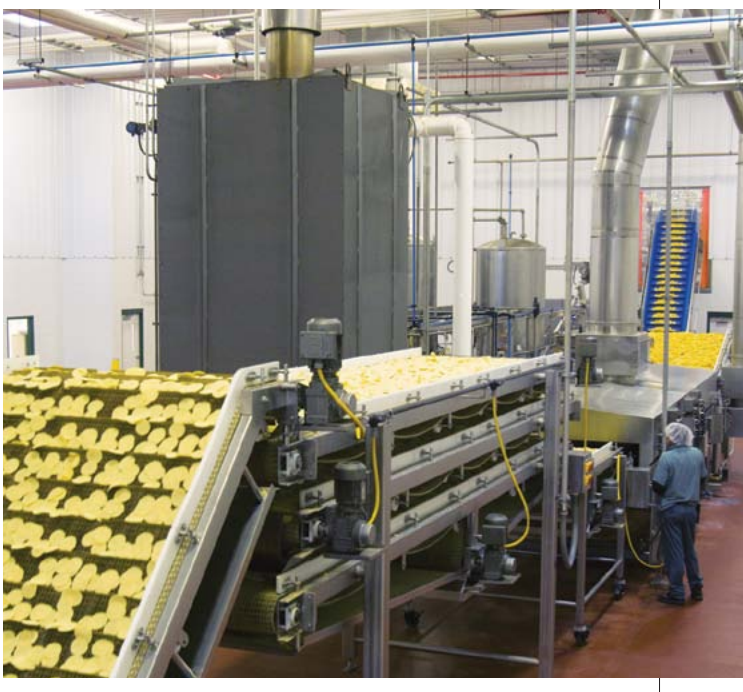
Some additional upfront cost already is paying dividends to this manufacturing organization, with the biggest returns yet to come.

Kevin T. Higgins, *Senior Editor* | Plant photo by Vito Palmisano for *Snack Food & Wholesale Bakery* Magazine

When sellers of financial derivatives and the Bernie Madoffs of the world dangle deals to double and triple capital virtually overnight, it's a wonder anyone invests in manufacturing. Spending on the production of goods is, with depressing regularity, viewed as a necessary evil to be minimized to the fullest extent possible.

In that context, the Massillon, OH project that Shearer's Foods Inc. began three years ago is remarkable. Rather than attempt to do it on the cheap, Chairman and CEO Robert J. Shearer declared the project would leverage new and existing technologies to create a manufacturing center that would squeeze every bit of productive use from energy inputs, while minimizing the amount of water consumed and waste generated. The effort would add 8 to 10 percent to the price tag, the snack food maker estimated, but he characterized the added cost as an investment in the future.

Fast-forward three years, and the realization of Shearer's vision is still unfolding on the rolling hills of northeastern Ohio. Project scope has expanded, not contracted, with the overall price tag increasing accordingly. Phase I was completed in March 2010, a 47,000-sq.-ft. showcase of engineering



Tortilla chips are conveyed to a fryer, then out of the production room and up to the packaging mezzanine for weigh-scaling. Extensive ductwork is tied to heat recovery systems that help lower energy requirements to run the line. Photo by Bob Rossiter.

innovation that earns the distinction of *Food Engineering*'s 2011 Plant of the Year.

With Phase I, the company mined a PR bonanza. The US Green Building Council granted platinum level certification to the Massillon facility under its Leadership in Energy and Environmental Design (LEED) program, making Shearer's the first food company—most certainly the first snack food manufacturer—to gain the distinction. Plaudits have rained down ever since. Ohio Gov. Ted Strickland was on hand at the plant's grand opening, heaping praise on the organization for its leadership in sustainable manufacturing. US Secretary of Energy Steven Chu paid a visit to see the state-of-the-art systems and groundbreaking innovations first hand and to add his own salute. Given Shearer's participation in the US Energy Star program since 2006, the company already was on the Department of Energy's radar. Replacement of large motors with smaller VFD units and installation of waterless urinals four years ago were modest harbingers of what was to come.

To compartmentalize the project as a LEED winner or a one-time stab at sustainable manufacturing is to give the Massillon plant short shrift. True, the company has made sustainability a core value, and key customers want Shearer's to drive waste reduction and efficiency throughout the supply chain. But the commitment extends beyond those relationships and impacts decisions about the companies it chooses to do business with. Long-term relationships with vendors are a point of pride, but friendships and loyalties didn't dictate equipment supplier selection. RFPs included not just throughput rates, maintenance considerations and other standard metrics, but also consump-

Help wanted: Growing firm seeks quality workers

Forget the Horatio Alger myths: A Wharton School case study on manufacturing nimbleness would be a better way to profile the growth arc of Shearer's Foods Inc. over the last three decades.

The company started in 1974 as a distributor, with manufacturing added five years later. Production in 1979 was limited to two batch kettles capable of producing 250 lbs. of potato chips a day. Today, management oversees 70 production lines in six facilities totaling almost 1 million square feet. Finished goods production reached 220 million lbs. last year as the company approaches $500 million in sales.

The Shearer family was engaged in the Canton, OH grocery business when son Bob decided he could make better potato chips than the brand he was distributing. Undeterred by an absence of any manufacturing or food production background—the difference between table-stock and chipping-stock potatoes had to be explained by a sympathetic observer—the group began developing a loyal following in northeastern Ohio. Soon after completing a major expansion of its flagship plant in Brewster, OH, Shearer's augmented its branded snack food production with private label production. Contract manufacturing later was added to the mix.

Access to capital is an issue for all privately held companies, and in 2005, Shearer's addressed the issue by selling a majority stake in the company to the McLean, VA equity firm Winston Partners. The deal paved the way to 2006's purchase of a snack food plant in Lubbock, TX. By the time Shearer's closed 2009's deal for a Canonsburg, PA pretzel plant and the March 2010 acquisition of Snack Alliance Inc.'s facilities in Bristol, VA and Hermiston, OR, majority ownership had passed to New York-based Mistral Equity Partners, which counts Country Pure Foods among its other food holdings.

As the size and cost of equipment needed to be a low-cost producer have increased, so too have the barriers to entry in snack production. The next generation of manufacturing entrepreneurs would do well to study the case of Shearer's, a firm with 1,530 employees where the biggest management challenge is finding more good workers.

Significant savings in both energy inputs and water usage were realized in the corn cook/soak system at Shearer's Foods Inc.'s Massillon, OH facility, *Food Engineering*'s 2011 Plant of the Year. Photo by Bob Rossiter.

tion of energy and water and the volume of waste generated. Investments must have a return, but if a superior design or advanced technology promised significant future savings through lower energy costs or enhanced product quality, there was wiggle room in ROI calculations. Consequently, some novel technologies and designs were incorporated, resulting in a plant with lines that outperform comparable ones in the Shearer's manufacturing network.

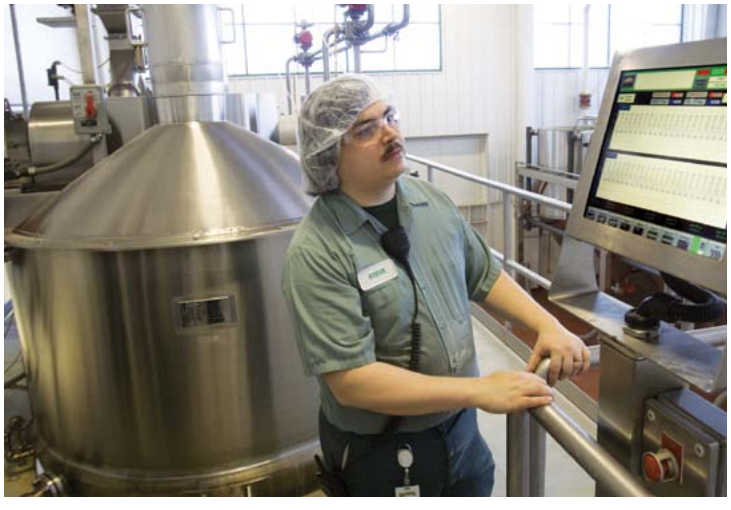
Calculated risks

All of the company's lines are scored on their consumption of gas, electricity and water and the amount of wastewater and landfill waste they generate to manufacture finished goods. Sustainability Director Scott Weyandt used lines in nearby Brewster, OH, the company's headquarters location, to document overall reductions of more than 30 percent. The efficiency focus didn't end with LEED certification: Also targeted are reductions of 50 to 60 percent in water use for a potato-slice washing system tied to six kettle fryers and a continuous fryer coming on line this spring. Advances introduced in Phase I will be duplicated in the addition housing the new lines.

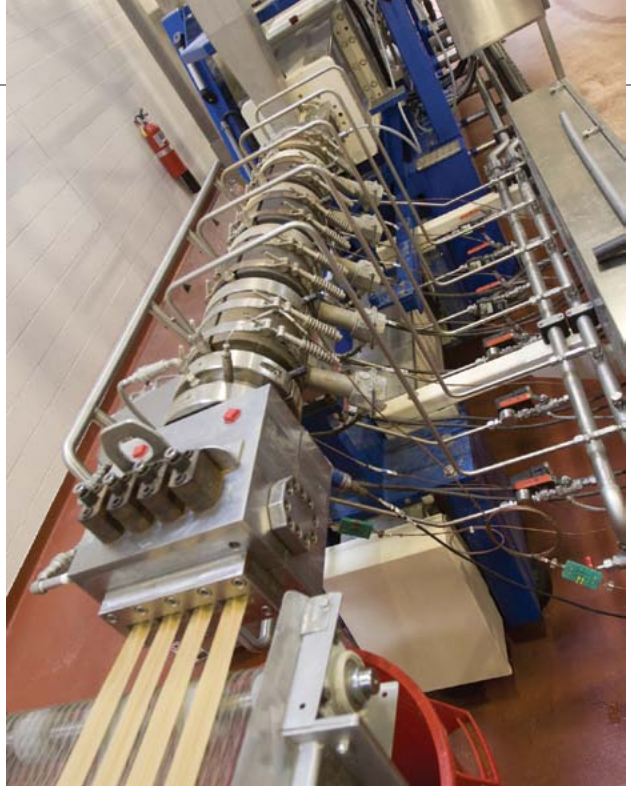
Some of the plant's improvements can be attributed to the organization's progression from a mid-sized manufacturer to a company with the size and financial wherewithal to deploy advanced controls and other automation tools. Others reflect Shearer's willingness to take a calculated gamble on technology's leading edge. Noting the presence of machines with serial numbers of one, two or three, Steve Surmay, senior vice president-copack operations, says, "We're not afraid to be first in the market" with equipment.

But on occasion, the dice come up snake eyes. The chairman and CEO recalls a foray into robotic case packing in the late 1990s. "I thought it was a great idea," Shearer remembers, but the technology wasn't there to support it. "Shearer's has always been willing to be a leader in our industry, and take chances on new technologies," he shrugs. "We've been lucky more than not."

Process drives energy consumption in food and beverage production, and the new plant's savings run from the beginning to the end of the tortilla line. Corn must be cooked, then soaked up to 11 hours before it can be used to form masa, the cornmeal dough used in tortilla chips. Coppell, TX-based Quality Fabrication (QF) engineered the corn cooking and transfer system that saves 1.7 billion Btus a year in gas consumption, or 16 percent of the total use, while reducing water consumption by a third. Similar systems are in place at many of the leading makers of tortilla chips, allows Harvey Norman, QF technical support leader, but they are rare for mainstream manufacturers. Two filters and PLCs are required to execute the cooking process and recycle about 250 gallons of water for the next batch in each kettle, but the additional cost and necessary technical support has left the system out of reach for many mid-sized manufacturers.



Steve Ferryman eyes SPC control charts in the corn cooking room at Shearer's Foods' Massillon, OH plant. Statistical process control is the core of the facility's quality, food safety and regulatory compliance system. Photo by Bob Rossiter.



Whole-grain chips with corn, bran and four different flours are extruded on the plant's twin-screw line. Healthier products are driving growth in salty snacks, and the complexity of those formulations often require twin-screw extrusion. Photo by Bob Rossiter.

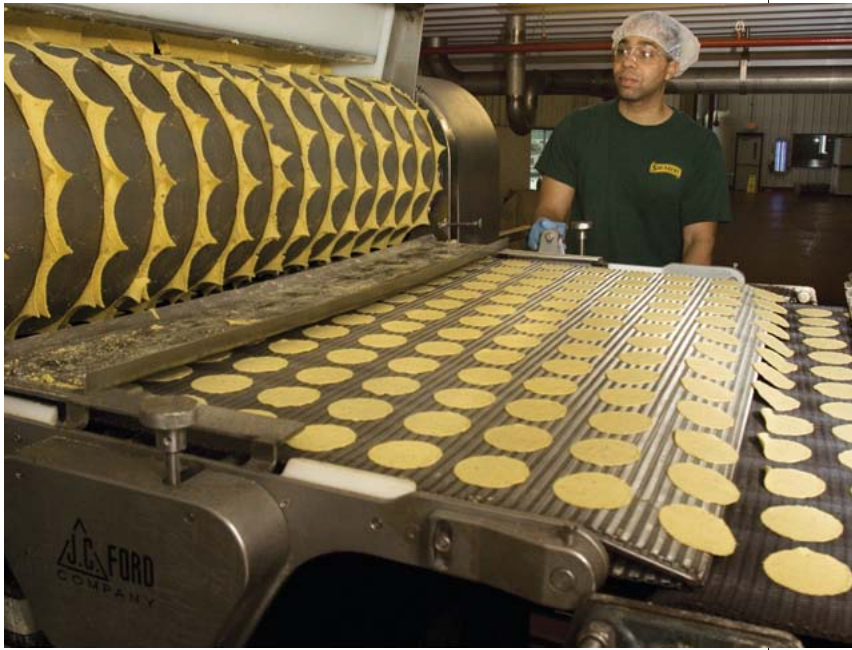
Serial No. 1 of a high-efficiency oven from IET Combustion LLC, also of Coppell, TX, can be found in the next room, where masa is formed and sheeted into the tortilla-chip line. Like QF, IET is an engineering firm low on the radar but well known to the industry's biggest players. President and Owner Souhel Khanania has retrofitted hundreds of snack food ovens. The Massillon plant provided his first blank canvas, and he responded with an oven that consumes 47 percent less gas than Shearer's benchmark units. The sealed cavity design of the oven box restricts air inflow into the oven by about two-thirds. Only about 800 cubic feet a minute (cfm) need to be heated. Rather than being sucked in from the room, the air is channeled through hollow beams that route the air to the infrared burners for even side-to-side heat distribution, a pattern that positively impacts product quality. "We utilize the frame as a means to transport air and the electrical conduit in a nice, clean design," Khanania explains.

The genius of the patent-pending design, however, resides in the burners. The oven is outfitted with four rows of burners, six at each level, to dry the chips with no more than half firing at any one time, depending on product load. According to Khanania, the ceramic burners deliver both radiant and convection heat, and they are engineered to minimize temperatures at the surface of the burner. "They are designed so that the surface is not subjected to the extreme temperatures" of up to 2,000˚F typically experienced by infrared burners, he says. Even metal-mesh burners are subject to accelerated deterioration at those extremes, he maintains. In contrast, some of his burners are still operating seven years after being placed into service.

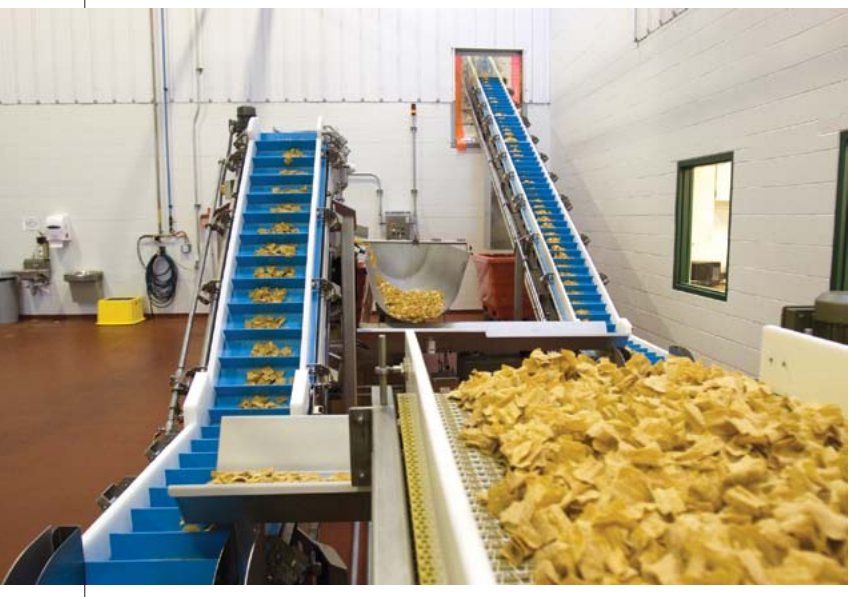
The low-draw oven is critical to the effectiveness of a liquid chimney heat-recovery system that feeds off the oven's exhaust. The chimney condenses moisture in the vented gas and routes it to a heat exchanger, where the heat is transferred to propylene glycol that delivers the heat to the building's HVAC system. The system was designed by Tom Kiser, founder of PSI Engineering in Fremont, OH, and a heating and ventilation engineer. His son Ed Kiser, also a mechanical engineer, explains, "We are thermal engineers, not just a HVAC job shop."

The ratio of vented water to chip throughput is a constant. What is different in the Massillon installation is the ratio of water to air volume going up the stack. "If 1,000 cfm of air is going through, I can condense out twice as much water and its latent heat than if 2,000 cfm is in the stack," explains Ed Kiser. "The sensible energy in water is very small compared to the latent energy, and extracting it is a challenge. With less air, there is more water in a given volume, making it easier to recover." Transferring heat from a gas to a liquid state also is believed to strip out some of the exhaust's pollutants, including carbon dioxide, but no studies have been done to quantify the impact.

Ed Kiser describes the building's HVAC as a "hydromechanical hot water heating system," with the liquid chimney heating glycol water mixture to 130˚F, and the return loop bringing it back at about 100˚F. During the warmer weather, the recovered



Rufus Williams watches as a dough-cutting drum cuts masa into a specific shape on the tortilla-chip line at Shearer's. The chips are baked in an infrared oven rated at 46.7 percent more efficient per pound of production than comparable ovens in the Shearer's network. Photo by Bob Rossiter.



A vibratory conveyor (center) serves as a surge buffer on the tortilla-chip line, which has a rated capacity of 5,000 lbs. of product per hour. Photo by Bob Rossiter.

heat is used to preheat water for the corn cook, sanitary applications and other uses.

Moisture from the tortilla fryer is dispersed for use in the liquid chimney, but a reduction of 2,190 MMBtu per year (9 percent) from the baseline load was realized with other efficiencies. The fryer's heat exchanger also is tied to the HVAC system, according to Norman of QF, which built the fryer. The Massillon plant hosts the first application of QF's air-combustion analyzer. Instead of using a pressure valve to regulate the amount of gas reaching the burner based on the amount of air, "we took it to the next level" with a Siemens controller that monitors the oxygen and carbon dioxide emissions in the exhaust, then feeds back the data to regulate the air-to-gas mixture. "It's expensive," Norman concedes, but extremely precise.

Bertha Yoder collects product from a vertical form/fill/seal station in preparation for case-packing. Because of the customized pack patterns and package-size variety required for copacking and private label work, production managers prefer the flexibility provided by manual case-packing. Photo by Bob Rossiter.

Squeeze play

Recently issued dietary guidelines from public-health authorities include explicit warnings about the hazards of salt, sugar and fat consumption. Snack food leaders in recent years have been altering formulations and introducing healthier options in an effort to get in front of expected changes in people's diets. Healthier-for-you products are a growing part of Shearer's portfolio: Trans fats have been replaced in most of its potato chips, and the Massillon plant's new kettles are paired with centrifuges that shed 40 percent of the oil prior to packaging. But more complex products like the firm's Shapers whole-grain chips are beyond the ability of single-screw extruders. The Massillon plant hosts the company's second twin-screw extruder (the first was installed in Brewster), and more are likely to follow as the healthier-eating trend grows.

Single-screw extruders suffice for cheese puffs and other simple snacks, but they represent "completely different science" and are incapable of the "micro-mixing between the screws" of a twin-screw extruder, according to Mike Shaw, a sales manager with Clextral Inc., the Tampa, FL OEM that engineered Shearer's unit. The six-barrel extruder gives the manufacturer great latitude in the textures and mouthfeels it can create in non-expanded snacks. The line is rated at 800 lbs. of throughput per hour.

Phase II effectively doubles floor space in Massillon to more than 110,000 sq. ft., with additional lines and more brick and mortar likely on the 34-acre site. Some of Phase I's innovations are duplicated in the expansion, including a second liquid chimney. Its recovered heat will warm wastewater bound for an anaerobic digester to about 90°F. Until the volume of methane from the digester is defined, gas will be flared, though a useful application is anticipated. Even without energy reuse, the case for anaerobic over conventional aerobic digesters was overwhelming, according to Weyandt.

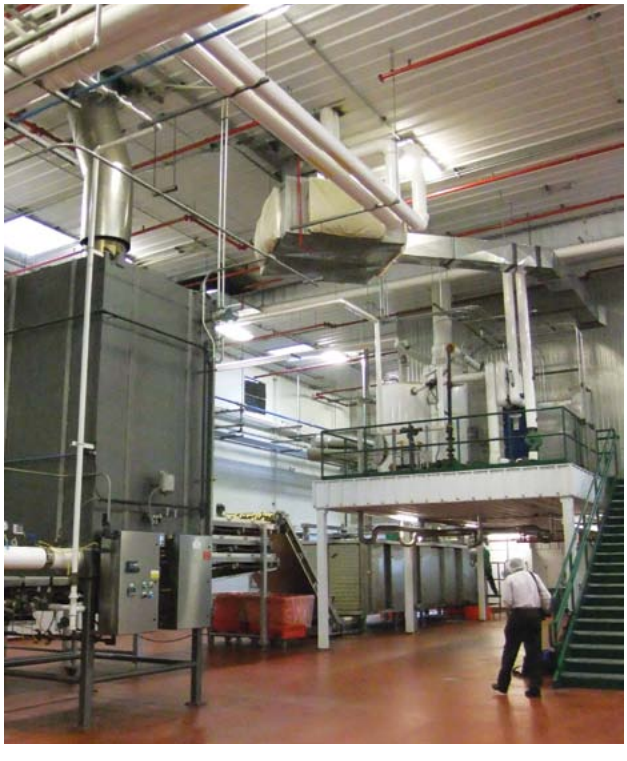
"Anaerobic as a process has multiple benefits," including reduced chemical requirements, less sludge and reduced labor, he says. Shearer's solicited bids for both anaerobic and aerobic systems and concluded the lower capital costs for an aerobic system would be wiped out within two years. Long term, aerobic was prohibitively more expensive.

Chairman and CEO Bob Shearer (left) and Scott Smith, president, discuss packaging changes at Shearer's headquarters in Brewster, OH. The men have guided growth at the snack maker, relying on close partnerships with key suppliers to keep the company in the front ranks of innovation and technical advancements.

Only one full-time person will be needed to maintain the Massillon system, compared to six at a comparably sized aerobic digester in Brewster. "As long as we have balanced pH coming into the system," anaerobic requires no chemical balancing, whereas GRAS polymers and chemicals are an ongoing expense with aerobic. "There are no blowers and very few motors and pumps involved" with anaerobic, which is not the case with aerobic, Weyandt adds. Finally, sludge must be dewatered and removed daily in Brewster. In Massillon, it's expected to be a "once every two or three years" event, he calculates.

A mechanical engineer with a specialty in polymers, Weyandt embodies a new breed of professionals at Shearer's. He was the first corporate engineer hired four years ago for a staff that now numbers five. Developing in-house expertise has freed the firm from reliance on suppliers' engineering expertise and enabled it to challenge those suppliers to develop new technical capabilities.

Until a major expansion of its Brewster facility in the late 1990s, Shearer's had fewer than 200 employees and prided itself on being an entrepreneurial organization built around quick-to-market nimbleness and a laser focus on core values such as product quality, food safety, sustainability and community relations. A more formalized and disciplined approach is required if a large organization is to exhibit those attributes. To that end, manufacturing professionals with and without food experience have assumed key management roles in recent years. For example, Director of Operations Ken Brower and Brad Johnson, Massillon's new plant manager, came to Shearer's from the automotive industry where lean and Six Sigma are essential elements in continuous improvement. Those methodologies are beginning to guide process improvements in Massillon.



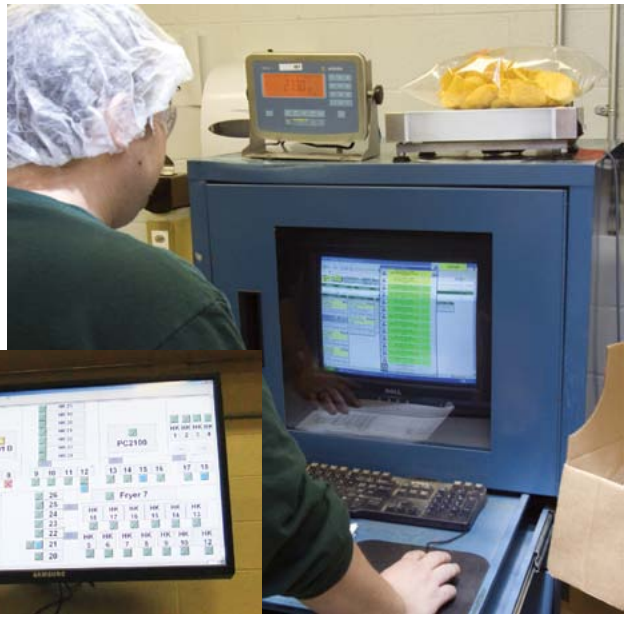
"We kicked off a kaizen event this morning," with a goal of cutting seasoning changeovers to below 15 minutes from 25-30 minutes, notes Brower, who joined the organization in late 2007. "That's something we're bringing in from the outside, and we're still in our infancy." But the company culture is receptive to change, and Johnson and he expect the staff to embrace new methodologies. If the changeover goal is met, Brower believes Massillon will be able to execute them daily instead of at five-day intervals, a significant benefit for manufacturing flexibility.

Simplicity and flexibility shape many implementations at the new facility. Instead of lift trucks, hand trucks are used to move pallets because anyone can transport loads as needed, without any licensing requirements. Case-packing is a manual operation as well, a protocol dictated by the multiple product sizes and pack patterns the firm's private label and copack clients demand. The absence of packaging robotics also means less technical support is required.

Integrated data streams

ControlNet is the data highway for machine functions. It also moves quality data that directly impacts how operators

The Massillon plant's liquid-chimney system is positioned on a mezzanine above the tortilla line. Exhaust from the oven is routed to the chimney, which utilizes a water curtain to extract heat from the gases and convert it to a liquid state.



Matt Freday performs a quality check on bagged product to verify the weight. A green checklist on the Infinity QS Dynamic Scheduler guides workers through standard procedures. If a check isn't performed or the results are outside acceptable operating parameters, the problem is flagged with a red spot on factory dashboards (insert) throughout the plant, alerting supervisory personnel. Photo by Bob Rossiter.

function and underpins the continuous improvement projects envisioned.

Data communication for human functions, on the other hand, is done through a statistical process control (SPC) program that extends beyond quality issues to include safety, sanitation, training and documentation of manufacturing processes.

Quality, food safety and compliance data are tied to statistical process control software from Chantilly, VA-based InfinityQS. Shearer's is one of the first food companies to install version 4, an advancement developed for Kraft Foods that includes an enhanced data management system, and Dynamic Scheduler, a program that manages operator start-up sheets, quality checks, packaging checks and other procedures. Scheduler's visual presentation is a ticking alarm clock, a cue to operators of an impending task and when it should be performed, explains Steven Voight, an InfinityQS application engineer who worked with Shearer's on the installation. If a task isn't executed or a problem occurs, the program notifies supervisors or technicians to respond.

To minimize chokepoints, precision weigh scales are controlled for continuous bulk-density recalibration as tortilla-chips arrive in the packaging department. Photo by Bob Rossiter.

"The Shearer's staff is very good at manipulating the software and making it do what they want it to do," says Voight. So it didn't surprise him when they integrated the quality software with many of the other programs, including ERP and a customized MES program named Manufacturing Information Portal (MIP). When a packaging run begins, the operator begins by scanning the package bar code. If the bar code is incompatible with the ERP's production schedule, the discrepancy is flagged and MIP locks down the pallet label printer, halting production until the correct package for the finished goods is scanned.

Flat-screen monitors provide at-a-glance views of machine states on the plant's lines, with green icons for normal operation, blue icons for idle equipment and red icons for machines with missed tests or other conditions. At the operators' stations, the InfinityQS Dynamic Scheduler quality application displays a green sheet of to-do tasks, such as sampling of packages to verify weights. Failure to perform a check on time immediately is reflected on the factory dashboards.

Senior Vice President of Operations Scott Heldreth spearheaded the customization of the SPC software to serve quality control objectives. "My background was originally centered mostly around technology and system implementations," explains Heldreth, who joined Shearer's a decade ago as CIO. He replaced all paper-based records with electronic documentation. Associated programs such as Qualtrax, which documents employee training and testing and the versioning

execution of standard operating procedures, and asset management records were brought into the quality database. The result is exceptional document control and the ability to meet customers' and regulators' audit demands. Gone are the days of "documentation through mostly brute force efforts," says Heldreth, "including manual audits, paper forms, individual notifications and manual tracking systems."

One payoff was the relative ease with which the plant received third-party certification through the SQF-level three program. Many food companies that have gone through SQF and other certified audits under the Global Food Safety Initiative have struggled with the documentation requirements. Timelines of a year or longer are not uncommon. Automated documentation and standardized procedures helped the Massillon plant achieve SQF level 3 certification in two and a half months, according to Don Asplin, corporate quality auditor.

Behavior modification

The bells and whistles of the typical LEED-certified building—high levels of insulation, argon-filled windowpanes, high-efficiency fluorescent lighting augmented by skylights and automatic dimmers—are evident at the plant. The substantive improvements are occurring, however, in the details of everyday processes and the challenging of conventional thinking, with small changes aggregating to significant efficiencies.

Compressed air is a case in point. "I hate compressed air," Weyandt confides, but some packaging equipment requires it. A compressor skid sits outside the plant, but low-friction piping boosts the efficiency of air delivery.

"The basic concepts and technology of sustainable manufacturing have been around for years," muses Weyandt. "Sometimes it's just a matter of how you pull them together on the floor. But you can't drive improvement with one or two people." The same is true of continuous improvement, and efforts to actively engage the entire workforce in improving productivity, quality and safety are expanding.

"Engagement on the shop floor has been a hallmark at Shearer's," adds Mike Parks, who joined the company in late 2010 as vice president-manufacturing. Lean initiatives sometimes are associated with staff reductions, a sore point with workers, but "when you're growing, you plug that labor back in somewhere else," he says. Ideally, workplace initiatives in sustainability, worker safety and other initiatives alter lifestyles and impact home behavior. "In communities where it works," he says of worker safety, "you drive down the street and see people wearing safety goggles while mowing the grass."

A water glycol-filled heat exchanger routes thermal energy recovered in the plant's liquid-chimney system to heat the building and for other uses.

With the founder's retirement drawing closer, there's a legacy element to the Massillon project and the broader initiatives at Shearer's. "You're never finished improving and innovating, because then you start going backward," reflects the company's namesake. In that sense, the Massillon plant is a stop on the journey to rethink manufacturing processes and systems, with thousands of customers, staffers and members of the community invited along for the ride. ❖

For more information:

Mike Shaw, *Clextral Inc., 404-944-4134*

Souhel Khanania, *IET Combustion, 847-946-5578, souhel@ietcombustion.com*

Steven Voight, *InfinityQS, 703-961-0200, svoight@infinitysq.com*

Ed Kiser, *PSI Engineering, 419-332-7373*

Harvey Norman, *Quality Fabrication, 214-801-2796, harveynorman@quality-fabrication.com*

692 Wabash Avenue North
Brewster, OH 44613
1-888-GREAT-CHIPS
www.shearers.com