

Bell's Brewery Optimizes Fermentation Process with Siemens Braumat PCS 7

When Bell's Brewery decided to upgrade the temperature control system on its 45 fermentation tanks in mid-2006, they were planning on simply expanding their existing system of dedicated single-loop controllers for each of its tank control points. Instead, Bell's opted to take a quantum leap forward by implementing a state-of-the-art process automation system for temperature control of its tanks – the Siemens Braumat PCS 7 Compact.

Essentially, a brewery controls and automation system-in-a-box, Braumat PCS 7 Compact is the first comprehensive brewery control system delivered in an extremely compact and cost-effective format. Combining the brewing expertise contained in the world-famous Braumat package, along with the automation technology platform of SIMATIC® PCS 7 BOX, it is a system that is specifically optimized for small- to medium-sized breweries.

Implementing this system made Bell's the first craft brewery in the United States to put in place a temperature control system that rivals the major brewers in efficiency, while providing scalability that encompasses all of its brewery functions in one controls package.

process AUTOMATION

Craft brewer, Bell's Brewery's new control system maintains tight temperature control in its 76 fermentation tank control points from one central location, provides scalability to incorporate all brew house functions, and integrates the renowned Braumat library, at a price point 20 percent lower than traditional single-loop control systems.

SIEMENS

Bell's Brewery, Inc., located in Galesburg, Michigan, is a privately held company founded by Larry Bell in 1983. Last year Bell's produced about 74,000 barrels of beer, ale, porter and stout in 26 different brand varieties. The majority of its production is ale, with brands like Bell's Oberon Ale, Bell's Winter White Ale, Bell's Amber Ale, Bell's Sparkling Ale, and Bell's Eccentric Ale. Bell's ranks as the 26th largest brewery in the U.S., out of a total of 1,400 brew houses, and the 15th largest craft brewery (based on 2006 sales, compiled by Information Resources (IRI) 2007, and released by the Brewers Association). Bell's currently distributes its products into twelve states.

Craft and micro brewing represent the fastest-growing segment of alcoholic beverage sales in U.S. supermarkets. According to IRI, in 2006 craft and micro brew sales were 17.8 percent above 2005 and almost 65 percent higher than imported beer, the next nearest alcoholic beverage category in growth.

Like many craft breweries, Bell's produced its first brew in a soup pot; in their case that pot was located in Larry Bell's home kitchen. For some time after, Bell's brewing set-up was a hodge-podge of different equipment, home-grown parts, varied control systems and manual operations, with little holistic approach, which is similar to brew house set-ups in more than 50 percent of small- to medium-sized breweries. In 2001 Bell's acquired a full-blown, full-process brew house - formerly Wolfgang Puck's Eureka brewery in Southern California - and installed it in Michigan, expanding it extensively in the process. Additional projects, mainly in the fermentation area, have greatly enhanced the brewery's capacity.

Fermentation Temperature Control

Bell's had been using single-loop controllers on its fermentation tanks and was considering installing additional controllers to service all 76 of its tank temperature control points. However, producing 26

different beers posed significant challenges in maintaining the optimum temperature profile for each variety, and as brew masters know all too well, control of temperature in fermentation is absolutely critical to maintaining beer quality and flavor.

"We wanted to utilize technology to make better beer," says John Mallett, Production Manager at Bell's. "There are breweries that are not as fastidious at maintaining temperature control as we are. Different beers will ferment at different temperatures - there are a whole host of flavor active compounds that are strongly influenced by fermentation temperature. If one of our brands of beer is fermented at the same temperature as another brand, the difference between those products would no longer be as distinct. For us, precision in fermentation temperature control is integral to maintaining our high level of brand integrity."

Implementing this type of precision temperature control using a system of individual single-loop temperature controllers had its drawbacks, because the record keeping of tank temperatures is a manual, paper activity, prone to human error and very labor intensive.

"We became aware of the new brew house controls package that Siemens had just released for small brewers," continues Mallett. "Initially, we were interested in its application to our fermentation process because of its ability to centrally control the temperatures of all 76 tank temperature control points from one location. Soon we recognized that it could achieve a much more precise level of temperature control than what we could ever achieve manually with single-loop controllers. With the controllers we had been using, we would set our temperature parameters daily, then manually check the temperatures of our tanks once or twice a day. The new Siemens system is capable of recording tank temperatures as frequently as every second, and adjusting the process automatically to maintain the desired temperature profile. For us, this offered a new level of precision in fermentation temperature control."

The New Braumat PCS 7 Compact for Smaller Breweries

Braumat PCS 7 Compact is Siemens SIMATIC PCS 7 BOX equipped with the Braumat Compact library integrated into the system, which has all the key functions needed for automation, monitoring and control, and engineering of a brewery. The Braumat Compact libraries for brewing were released to the craft brewery market in September 2006. Because it is fully scalable, Braumat PCS 7 Compact can be expanded at any time in the future with no compatibility problems or re-training needed. It can be integrated into any existing PCS 7 environment and is perfectly suited for smaller production applications, like craft breweries, or self-contained sub-processes.



PCS 7 Box compresses the functionality of a complete DCS into a compact industrial PC platform which features an integrated hardened controller that operates independent of the PC. It is actually a hybrid PLC/DCS unit, providing the best features of Programmable Logic Controllers (PLC) and Distributed Control Systems (DCS) integrated into an ideal crossover application suitable for the requirements of the hybrid industry. It offers the world's only platform that integrates new and existing automation systems (process, batch, discrete and safety) and devices (instrumentation, analytics, motors, drives, and safety instrumented functions) within a single platform. The system provides common tools for engineering, visualization, and plant-wide asset and maintenance management. It also supports complete fieldbus connectivity without compromising features by going to a compact size.

"We took the control algorithms from the standard Braumat Classic package, and then ported them for use on the PCS 7 platform," says Ed Montgomery, Brewing Industry Manager with Siemens. "Bell's had heard of Braumat, but always thought that it was only for the big breweries, they did not think they could ever afford it. In the past Braumat Classic could have been cost-prohibitive for craft breweries, but we were able to show them that Braumat PCS 7 Compact was affordable for a small brewer, like them, to use."

Improved Configuration, Quality Monitoring and Recipe Management

Braumat PCS 7 provides a complete information management system, so all of a brewery's fermentation data goes directly into PCS 7's built-in data historian, where it is stored and managed. Bell's now has the capability for trending, archiving, and data analysis of its key process variables, as well as process debugging such as quick backtracking to determine the cause of problematic batches.

"There is a lot of interest with brewers of our size wanting to work smarter, not harder, taking man-hours out of the day, and working more efficiently," says Mallett. "We have always made better beer each year. With the system changes, we now also make beer more efficiently and have removed variability and repetition."

The system lets brewers react quickly to changes in production, enabling flexible planning of orders and batches. Additionally, the system makes it more convenient to create new recipes because brewers can easily modify and adapt processing sequences and parameters such as volumes, temperatures, specific gravity, pH, and time intervals.

Scalable Architecture for Future Growth

The ease of being able to integrate new applications into PCS 7 was another reason behind Bell's decision to go with this system. One of the strong advantages was the open architecture of the system, which would allow them to bring in other processes within the brew house.



Bell's chose the Braumat PCS 7 Compact so it could migrate from a small temperature control system, the installation it now has, to a full-blown PCS 7 client/server system that could control the entire brewery facility. Siemens was able to provide a solution that was fully scalable to its future needs, without the need for any re-engineering or re-training of the brewery staff.

The brewery is using another Siemens system in their facility as well, which they have had for some time, to run their Brew House, the S7-400 PLC.

The S7-400 PLC system was originally part of a stand-alone control package," says Mallett. "We will be able to integrate it into our new PCS 7 system. So, instead of having multiple, different systems in our brewery, taking up physical space, using intellectual resources to maintain and monitor, we can bring that all into one centralized location which could be maintained using a common set of tools."

One advantage with PCS 7 is that, in the future, all of Bell's automation controls can be easily integrated within its infrastructure. The functions that can be brought into the system are virtually unlimited. It can run everything from grain handling through the brew house, fermentation, filtration, carbonation, pipe routing, all the way up to finished beer and packaging.

"We can now modify the way various functions of our brew house system operate with a great degree of ease," continues Mallett. "There is flexibility in standardization. This is a huge issue for us. For example, tying in our yeast production with Braumat will allow us to integrate a new propagation system which is twenty times larger than our current equipment into the Braumat platform."

Additionally, during the initial carbonation phase of our bottle conditioning process, our cellar operators currently charge the system, then manually take multiple samples

over time, continually having to monitor and manipulate the gas flow to achieve the correct level of carbonation. With the recent installation of a new system that includes Siemens sanitary mag flowmeters, we will be able to automatically control carbonation to a desired setpoint on the fly, all from within the integrated Braumat system."

Optimized Cooling Performance

Many brewers do not always have the resources available to smoothly manage temperature control in their fermentation process. There can be maximization on how much cooling can be done, and how timely it can be achieved.

"We are now capable of truly optimizing how much cooling can be done in our fermentation tanks, and how fast that cooling can be realized," Mallett says. "Many smaller brewers are negatively influenced because their cooling capacity is stretched to the edge. Fermentation creates heat, and we want to take that heat out of the fermentation process to control temperature, which is achieved by circulating a glycol solution in jackets around the tanks. The demand for cooling can sometimes exceed the system's capability. Because the PCS 7 system is continuously monitoring and automatically making adjustments, it can spread the heat exchange load out more evenly over time, eliminating temperature swings and maintaining more stabilized temperatures in the tanks. The improved performance within our fermentation process is clearly evident."

Improved Workflow and Throughput

Although Bell's new system has just recently been installed, performance statistics are evident and significant. The new fermentation control system has allowed the brewery a quicker throughput, reduced labor-hours, and the system is easy to operate.

"We have considerably reduced our labor-hours as a result of putting in place the new system," continues Mallett. "Doing one to two manual checks per day, for each of our fermentation tanks, was serious man hours, typically a two- to three-person activity. Now, this is all controlled from one central location in a fraction of the time. These man hours are now being put to use on other activities in the brewery. With efficiencies like this, we will continue to systematically integrate our other brewhouse functions into the system."



"The small- to medium-sized brewer is faced with a host of production challenges every day," Mallett says. "If the task of fermentation temperature control can be automated, as with the PCS 7, to a point where it is no longer an issue to be dealt with daily, that frees up our attention to focus on other problems within the brewery."

"The actual installation of the automated system only took a couple days, but part of this whole process was training our staff on the new system," adds Mallett. "Our maintenance people, operators, and engineers were all trained on it, which took a little more time. Siemens not only supplied the product, they also provided the process knowledge that goes with its use."

The cost for the entire Braumat PCS 7 Compact system installed at Bell's Brewery for the fermentation temperature control came in at about 20 percent lower than the costs estimated for the single-loop controllers, while also providing significant improvement in brewhouse capabilities.

Bell's was the first brewery in the United States to install the Braumat PCS 7 Compact system. There are roughly 300 more craft breweries in the U.S. who can look forward to benefiting from this technology.