

Case Study: New Belgium Brewing Company

Opto 22 SNAP PAC System Helps Brewery Improve Production Processes and Sustainability Efforts

Background

New Belgium Brewing Company, based in Fort Collins, Colorado, was founded by Jeff Lebesch, who brewed the company's first beer, Fat Tire Amber Ale, in the basement of his home in 1991. (Fat Tire takes its name from a bike trip Lebesch took through Belgium on a fat-tired bicycle.) Today, New Belgium produces a number of popular brands, including Sunshine Wheat and Mothership Wit beer, and Mighty Arrow Ale. The company has a focused distribution west of the Mississippi and is so successful, it has experienced double-digit growth every year for the last several years.



To handle its extensive brewing processes, New Belgium's 50-acre, multi-building facility is outfitted with Opto 22-based control systems. The Opto 22 hardware handles all of the facility's brewing processes, as well as the water process systems and virtually all other building management and facility systems. In total, over 10,000 individual digital and analog I/O points are monitored and/or controlled. The systems also play a major role in New Belgium's unparalleled sustainability efforts and its state-of-the-art cogeneration system, of which the brewery is very proud.

Brewing

New Belgium has essentially established eight "zones of control" for its facility. Seven of the eight, including the complex brewing processes, are controlled by Opto 22 programmable automation controllers (PACs). Among New Belgium's seven zones are the brewhouse, filtering, and malting—where the PACs control oven temperatures as the grains are dried and roasted, as well as various

machines that crush malt, break apart grain kernels, and mash ingredients used in the various brewing recipes.

The PACs also monitor and regulate the temperature of water before it's added to the brew, and the temperature of the brew itself as it "rests" and the various enzymes begin to activate.

"A rest is basically a waiting period, during which starches in the grains are converted to sugars so fermentation can occur," says Igor Valuyev, Chief Electrical and Automation Engineer at New Belgium.

The Opto hardware expertly handles all other processes relating to the brewing—such as boiling, blending, temperature and pressure regulation, and highly complex cascading proportional integral derivative (PID) control loops, where the output of one PID loop calculation is used as a process variable input for calculations in a second PID loop. It was New Belgium's automation team that created these control strategies. The brewery has a very high level of automation for its size and the team has worked very hard to make the company unique by using their expertise to take control of processes and maximize the functionality of the Opto 22 control systems.



Opto 22 SNAP PAC hardware and software

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For example, the automation team carefully monitors and controls boiling temperatures in kettles as hops are added. This is a critical process that must take place within strict parameters, as the boiling process not only terminates enzymatic processes but also helps sterilize the brew.

“We have many different malt recipes,” Valuyev notes. “To ensure that each comes out perfect, the Opto systems must perform to very specific operational standards. Mashers, mixers, milling systems, chilling systems, filtration systems, and our other equipment must all be made to work together.”

The Opto 22 hardware controls and continuously polls these machines to ensure that all processes are running properly, while production workers manage these processes using human-machine interface (HMI) screens created with the Opto 22 software by Valuyev.

Fermentation

During yeasting and cellaring (two more of New Belgium’s eight zones of control), the brew is moved to a special vessel where yeast is added. Fermentation then takes place, as the yeast converts the sugars from the malt into alcohol. Valuyev has programmed his SNAP PAC System™ to operate New Belgium’s fermentation systems differently based on the type of beer being brewed. Ale fermentation, for example, occurs at warmer temperatures than fermentation of beers, so precise control is needed in order to avoid wasting time and ingredients by brewing bad batches. For these fermentation processes, New Belgium uses PID control to maintain the tank temperatures and keep the brew within the designated temperature profiles. The Opto 22 SNAP PAC processors at New Belgium can perform up to 96 PID loops, which more than meets the company’s needs. Additionally, due to the SNAP PAC System’s distributed architecture, these loops run on the I/O units rather than on a single master controller or PLC. This is significant because even if, for some reason, the I/O unit loses communication with the controller (or if the controller inexplicably fails) the PID loops will continue to run—thus ensuring that no brew will be spoiled.

Also part of the yeast zone is control of New Belgium’s clean-in-place (CIP) systems. The CIP system gives the brewery a way to clean its multitude of pipes, vessels, and fittings, without disassembly. New Belgium’s system is fully automated by the Opto controllers that connect via analog and digital I/O points to activate the steam and the necessary valves, heat exchangers, injectors, and spray nozzles needed to flush, sanitize, and rinse the equipment.

Wireless Capabilities

One particularly interesting aspect of New Belgium’s automation architecture is the fact that the brewery features wireless Ethernet throughout the facility. Valuyev and his team leverage these wireless capabilities to the fullest extent.

“Our operators can be anywhere—at lunch, in the break room, or even outside the building—and still see, in real time, what’s happening with our brewing processes right there on their laptops,” he says.

Packaging

The only major processes at New Belgium not automated by Opto 22 systems are packaging and bottling. These processes are controlled by PLC-based Allen-Bradley® Logix systems. Even so, Valuyev has high hopes for mixing this platform with the Opto systems, because the SNAP PAC hardware recently added support for the EtherNet/IP™



New Belgium was one of the first wind-powered breweries.



Many employees at New Belgium help the environment by biking to work.

communications protocol—the protocol developed by Rockwell Automation (parent company of Allen-Bradley) and used by its Logix and other Ethernet-based automation systems. This gives Valuyev the option (should he choose) to integrate the Allen-Bradley systems with the SNAP I/O and controllers, and have the two communicate and share data.

Water Processing & Sustainability

New Belgium isn't simply in the business of producing and distributing world-class beers. The third largest craft brewer in the U.S. takes pride in being a responsible corporate role model with progressive programs that promote green policies and preservation of the environment. New Belgium was one of the world's first wind-powered breweries and has



Methane collected in a giant balloon is transported to the New Belgium facility and used as fuel

retained this commitment to wind power for more than ten years now. The company belongs to "1% for the Planet," an international organization whose members, through donations and fund-raisers, contribute one percent of their annual revenue to environmental causes. And to encourage green-powered transportation, each New Belgium employee gets a free custom cruiser bike after 1 year of employment.

Perhaps the finest example of New Belgium's commitment to sustainability is in its management of its water and wastewater. In 2002, the company completed installation of its own water treatment facility. Wastewater from New Belgium is transferred to this plant, where it's put into a series of large ponds and treated with bacteria that feed on and break down any organic wastes in the water. The by-product of this "pathogen purification" treatment process is methane gas, which collects in a large membraned, balloon-like container. This methane is then piped back into the New Belgium facility, where it's used as fuel for a combined heat and power (CHP) engine that produces both electrical and thermal energy. Ten to fifteen percent of the brewery's power comes from this methane gas "co-generation" source, which decreases the demand on the city of Fort Collins significantly.

As with the brewing, the SNAP PAC System monitors and controls aerobic and anaerobic water treatment, including pH stabilization, sludge dewatering, and all auxiliary processes.

System Migration

The SNAP PAC System New Belgium is utilizing replaces older *mistic*-based control systems. Why the upgrade? While the original system worked well, Valuyev was forward-thinking. Knowing that New Belgium was a fast-growing brewery, Valuyev wisely made plans for an upgrade to the SNAP PAC System.

"The *mistic* system utilized an ARCNET communications platform with performance measurably slower than the Ethernet platform the SNAP hardware works on," he explains.

New Belgium also needed a hardware platform that would work with Wonderware®, one of the company's preferred software platforms. Opto 22's OptoOPCServer is a SNAP PAC System-compatible, OPC-compliant server that New Belgium uses to pass data between controllers and PCs running Wonderware products. Furthermore, New Belgium is a 24/7 operation, with processes taking place continuously. The SNAP PAC controllers feature "background downloading," which

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means they have the ability to remain up and running while new control strategies are downloaded to them. Moving to the SNAP PAC System platform thus gives Valuyev the ability to modify and improve his control processes or make changes in his logic any time he likes, without disrupting the brewery's round-the-clock performance.

New Belgium started the upgrade in September 2007 and used PAC Project Professional, the automation software suite for the SNAP PAC System, to migrate the old *mistic* control strategies.

"PAC Project Professional includes an import utility for migrating commands used with our legacy systems," says Bryce Nakatani, Senior Application Consultant at Opto 22. Nakatani is part of the company's Product Support Team, which provides free technical support to New Belgium and other Opto 22 users.

"This import utility allowed New Belgium to upgrade to the newer [SNAP PAC] hardware and software and import the bulk of its existing control strategies."

What's Ahead

New Belgium's complete upgrade to the SNAP PAC System should be completed by the end of 2008. In the future, Valuyev sees a possible expansion which would require deployment of still more Opto hardware.

In the meantime, New Belgium continues to be one of the most successful brewers in the country, with leading-edge technology that helps it achieve both its high production standards and its corporate goal of environmental stewardship.

For more information, visit www.newbelgium.com and www.opto22.com.



About Opto 22

Opto 22 develops and manufactures hardware and software for applications involving industrial automation and control, remote monitoring, and data acquisition. Opto 22 products use standard, commercially available networking and computer technologies and have an established reputation worldwide for ease-of-use, innovation, quality, and reliability. Opto 22 products are used by automation end-users, OEMs, and information technology and operations personnel. The company was founded in 1974 and is privately held in Temecula, California, USA. Opto 22 products are available through a worldwide network of distributors and system integrators. For more information, contact Opto 22 headquarters at +1-951-695-3000 or visit www.opto22.com.