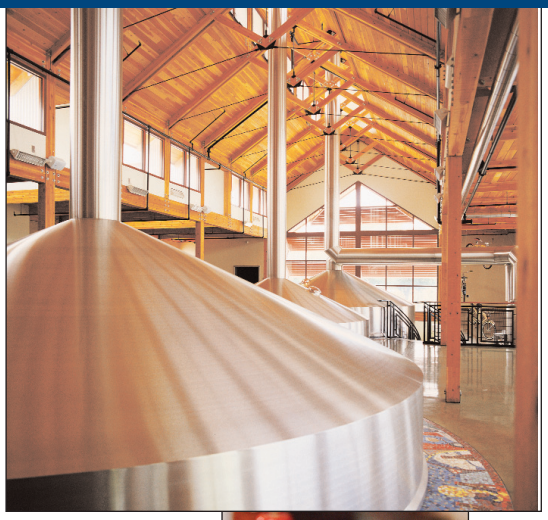
Hach COD—
Treating Brewery Process Water On Site



Process Water Conservation, Treatment & Recycling Minimizes Water Consumption

by Mandy Miller

New Belgium Brewing Company today reuses much of its process water for evaporative cooling, cleaning, and landscape purposes. On-site digestion by aerobic and anaerobic bacteria to reduce the organic components in process effluent, coupled with a continuous testing program to accurately monitor the most important sources of high organic loadings within the brewery, have been important keys to the breweryís successful process water treatment and re-use program.

For every barrel of beer a typical brewery produces, an average of eight to 10 barrels of water are consumed. New Belgium Brewing Company in Fort Collins, Colorado, produces one barrel of beer using about four barrels of water, thanks in part to a strong company-wide commitment to resource recovery that includes on-site process water treatment and an ambitious water re-use program.

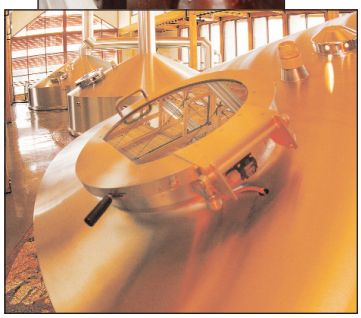
New Belgium Brewing Company is the fifth largest craft brewery in the country; it produced more than 320,000 barrels of beer in 2004, including the breweries flagship brew, Fat Tire Amber Ale. The company strives to be on the cutting edge of technology to best meet its high objectives for environmental stewardship, minimizing resource consumption, maximizing energy consumption, and recycling.

In addition to its water reuse program, for example, electricity is generated onsite, fueled by captured methane from the breweryís process water treatment plant. The on-site generator currently supplies enough electricity to run the breweryís entire main building for approximately seven hours per day. This off-sets peak demand charges from the local utility grid as well as significantly off-sets a portion of the premium the brewery pays for purchasing grid-supplied wind power, a decision it made in 1999 to reduce its carbon dioxide production by approximately 1,800 metric tons a year.

Wastewater Treatment

New Belgium Brewing Company initiated on-site process water treatment in 2002 in an effort to minimize the strength and volume of water discharged to the City of Fort Collins' wastewater collection system and, through re-use, to further reduce the amount of water required to produce each barrel of beer. The existing treatment facility (currently under expansion) has a rated capacity of 80,000 gallons/day. Average daily flows for 2004 was 58,274 gallons, and the plantís total outlet flow for the year was about 20 million gallons.

The automated process water treatment plant, supplied by German systems provider Von Nordensköld, includes a three-stage anaerobic digester, an aerobic lagoon, a biofilter and an aeration pond. Anaerobic treatment is followed by aerobic post-treatment, with anaerobic digestion taking care of approximately 80 percent of COD removal and aerobic digestion providing finishing treatment.



High Organic Loadings

As in all breweries, most of the organic content of New Belgiumís effluent is derived from the wort extraction process, wort residues in by-products, and wort and beer losses during subsequent processing. Autolyzed yeast from the fermentation process also contributes significantly to organic loadings in the process water effluent. Through anaerobic digestion, the bacteria in the wort and spent yeast breaks down simple sugars and starches and converts them to methane gas.

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The organic loading of the process water effluent is significantly high, due to the breweryís low water usage ratio. Whereas a typical breweryís process water effluent has an average biological oxygen demand (BOD) of less than 3,000 mg/L, New Belgium Breweryís process water effluent averages 7,500 mg/L.

COD Monitoring Critical

Although high organic loadings are ideal for anaerobic digestion and the subsequent production of methane for fuel, it demands continuous water analysis to monitor the treatment process and aid in process control. The major aim of the testing is to measure chemical oxygen demand (COD) and other parameters at scheduled intervals to provide a means to quantify waste strength variability to assist with the breweryís aggressive process water treatment and waste minimization efforts.

The quality and quantity of process water effluent entering the on-site treatment plant can fluctuate significantly, depending upon the different processes that are taking place within the brewery. Because the five-day incubation period for BOD analysis makes this test too slow to provide timely information for process control purposes, the in-house lab runs scheduled COD analysis at all effluent outlet flumes throughout the brewery. Because COD test results can be obtained in about two hours instead of five days, it gives the brewery a more timely analysis of loadings entering and leaving the treatment plant and provides a timely indication of plant performance, thereby permitting closer process control.

Two-Hour COD Test

For scheduled COD testing, the brewery uses the Closed-Reflux Micro Method using Hach COD digestion vials. The pre-dosed reagents are contained in 16-mm glass tubes, or vials, that fit directly into most commercially available COD reactors and spectrophotometers. COD testing is a very straightforward procedure at the brewery. After 2 mills of sample are added to a vial, the vial is capped and placed in a reactor to digest at 150ºC for two hours. After the vial is cooled, results are then read directly on a spectrophotometer. The lab uses a Hach DR/2500 Spectrophotometer, which provides personnel the ability to save COD and other frequently used programs for quick access.

Once COD and BOD data has been gathered over time, the average BOD result is divided by the average COD result to determine the ratio, or conversion factor. The COD results are multiplied by this factor to estimate BOD concentration. COD values are almost always higher than BOD results for the same sample, therefore the conversion factor is most always less than one.

In addition to scheduled COD monitoring of its process water effluent, the brewery has also periodically used the COD closed-reflux micro method in its brewhouse. For example, the brewery recently conducted a weak wort recovery test to determine the volume of extract and actual sugar loss following the dumping of spent grain. The brewers wanted to determine if they were simply dumping extra sugars, or was the weak wort worth recovering. A series of COD tests on the weak wort determined substantial levels of unused food remained. Based on this testing, the brewery now recovers this material for re-use in the brewing process.

Current Expansion

New Belgium Brewing Company is currently expanding its process water treatment plant to include additional anaerobic and aerobic digestion capacity. Holding ponds are also being added prior to the anaerobic digesters. The amount of methane produced has varied according to effluent volumes entering the digester, which has depended primarily on the amount of beer production at the time. The new holding ponds will serve to level out flow volumes entering the digesters, resulting in the production of higher, more consistent levels of biogas. This, in turn, will allow the on-site power generator to run for much longer periods, thereby reducing power costs for the brewery even further. In addition, a reverse osmosis unit is being installed to further polish the final treated water.

From an average BOD of 7,500 mg/L in flows entering the process water treatment plant, water leaving it has an average BOD of less than 25 mg/L, making it ideal for non-potable uses at the brewery, including evaporative cooling, cleaning, and for landscape purposes. COD and BOD reduction through the entire plant in 2004 was 98 percent and 99.8 percent, respectively.

Conservation, Treatment & Recycling

The combination of water conservation, treatment and recycling is allowing water consumption at the New Belgium Brewery to be controlled to a minimum. It has also eliminated the discharge of high organic loadings to the local municipal treatment system, which is verified quickly and systematically through accurate COD analysis. And, through the use of methane-fueled cogeneration, on-site process water treatment is significantly reducing the amount of purchased energy required to operate the brewery.

About the Author
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