Hopping Right Into Ethanol

For some ethanol plants, controlling gram-positive bacteria is a continuous battle. With resistance to antibiotics on the rise—and distillers wet grains being produced in greater quantities than ever—producers are turning to alternative anti-contamination agents like IsoStab, a natural hops-based product that thwarts germs and allows yeast to dominate.

By Tom Bryan
ops, “the spice of beer,” have been used in brewing for over a millennium. This pinecone-looking plant is known to impart bitterness, aroma and preservative properties, giving beer its flavor and keeping the beverage fresh between production and consumption. For decades, scientists have gradually unraveled the mysteries inside the hop cone. What they’ve discovered—and what they’re still figuring out—says William Popa, may bring about small but important changes in the way ethanol is produced.

Popa, ethanol project manager for BetaTec Hop Products in North America, tells EPM that many of the active compounds found in hops—more specifically, the same organic acids that make beer bitter—are known to have antimicrobial qualities. “It’s why breweries don’t have biological outbreaks,” explains Popa, who helped BetaTec introduce its flagship hop extract for ethanol production, a liquid product trademarked IsoStab, at the 2005 International Fuel Ethanol Workshop & Expo in Kansas City, Mo.

Now, after a period of extensive research and development, and a successful introduction of IsoStab in the U.S. market, BetaTec, a subsidiary of German-owned Barth-Haas Group, is working closely with its global ethanol industry customers to develop new and improved all-natural ethanol fermentation products. As Popa explains, controlling the formation of gram-positive bacteria is the name of the game for BetaTec—and doing it with natural products has big-time appeal for its new target customers.

Natural bacteria buster

While most U.S. producers have learned how to effectively control bacterial contamination, it’s still one of the industry’s leading causes of ethanol yield reductions. It’s also a big drain on product quality. To be able to operate cost-effectively, it’s vital to control bacteria in ethanol fermentation. For some producers, this is commonly achieved by adding antibiotics as a processing aid during fermentation. However, rising concerns about the role of antibiotics for agricultural and technical applications—especially after the emergence of antibiotic-resistant bacteria—is creating a strong demand for safe, natural alternatives. “More and more ethanol producers are seeking to produce distillers grains that can be labeled ‘antibiotic free,’” explains Lilith Ruckle, BetaTec’s European ethanol project manager. “In the European Union, for example, if fermentation coproducts are used as animal feed, they must not contain residues of antibiotics. This law became effective at the end of 2005. Other nations have implemented similar laws and some believe the United States could eventually follow suit.”

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Now There is a Natural Way To Control Bacteria During Fermentation

IsoStab™

IsoStab™ is composed of acids that appear naturally in hop plants.

Benefits:

- Improved alcohol production with less corn
- Controls lactic and acetic acid formation
- Stabilizes plant production
- Enables antibiotic-free products

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In addition, Popa says more and more U.S. ethanol producers are trying to get away from drying distillers grains in order to cut costs. “With wet cake, the fear is that the product still might have antibiotics in it—particularly amoxicillin or virginiamycin—which goes right into the cattle feed,” Popa says. “Our product is an all-natural, kosher-certified, food-grade additive. … It’s very safe.”

During the manufacturing of fuel ethanol, bacteria contamination can occur in nearly every step of the process where water and starch are present at temperatures below 104 degrees Fahrenheit, Ruckle says. Since corn and other grain often pick up bacteria in the field, contamination generally originates from the starch material. Washing the grain helps lower the bacteria count, but bacteria contamination is essentially unavoidable. Ruckle says bacteria contamination is often found in yeast propagators, steep tanks, fermentors and heat exchangers, where the temperature, pH and glucose levels are ideal for bacteria growth. “Bacteria can grow nearly 10 times faster than yeast, so contamination in these areas becomes inevitable,” Ruckle explains.

To minimize bacteria contamination, most ethanol plants clean this equipment on a regular basis and run their processes at low pH levels. Many plants also try to perform their steeping, mashing and fermentation as quickly as possible to minimize lactic acid formation. Unfortunately, even low levels of bacteria reduce ethanol yield and, if severe enough, can slow or stop fermentation. Many batch ethanol plants use antibiotics daily to avoid bacteria problems; others use antibiotics when bacteria problems get severe. Continuous fermentation plants rarely use antibiotics, but they will if bacteria contaminations are high. If no antibiotics are used, it is common for a plant to experience a 1 percent to 5 percent loss in yield. For example, a 50 MMgy ethanol plant operating with a lactic acid level of 0.3 percent (weight-by-weight) is losing approximately 570,000 gallons of ethanol annually due to bacteria, according to Ruckle.

If it works for making beer …

Historically, six hops have been used in brewing, and over the past 40 years, the hops industry has developed into a high-tech ingredients supplier to the world’s brewing industry. BetaTec Hops farm, manufacturing plant located in Washington’s unique Yakima Valley

BetaTec Hop Products was founded in Nuremberg, Germany, in 1997. The company is a subsidiary of the privately held Barth-Haas Group, a company formed when U.S.-based John I. Haas Inc. merged with German-based Barth. The company is the largest hops grower and hop products manufacturer in the world and bases its U.S. commercial operations in Yakima, Wash., located in the climatically unique Yakima Valley.

Before merging with Barth, John I. Haas had been a supplier to the brewing industry for more than 100 years. The company’s Yakima operations include a hops farm and manufacturing campus that has a cold storage facility, pelletizing plant, carbon dioxide extract plant and isomerization plant.

Carbon dioxide is used to extract hop acids. “This extract is a thick, sticky substance,” says William Popa, senior vice president of new business development for BetaTec Hop Products in North America. “It’s almost a molasses-like material.” The extract is isomerized, or broken down, into a very pure liquid product that can be easily used in the brewing, beverage alcohol and ethanol industries.

The climate in the Yakima Valley is ideal for growing hops because it rains only about three months out of the year there. “The rest of the time, it’s desert-dry,” Popa says. “Plus, the soil in the valley has a lot of volcanic ash in it.” The Yakima Valley also gets approximately 16 hours of sunlight per day during the peak growing season, giving the hops just what they need—a wet spring and a dry summer.

Hops will typically grow from March until they’re picked in late August. “They grow on vines like grapes,” Popa says. “You actually have to train them and put them up on a string, so they grow up in the air and off the ground. There’s quite a bit of labor involved.”

A large portion of the brewing industry still uses hops pellets in their cookers. “They’ll throw pellets in their cookers for flavor, texture and foam characteristics,” Popa says. “Each variety of hops will give a different characteristic to the beer, or in some cases, spirits. “If you’re making rye (whiskey) and you want a little more tang in there, you throw a little hops in.”
The growth of bacteria common to fuel and other environments is vital and actually produce alcohol faster. We are just trying to feed enough of the yeast to control it. What we have found is that by feeding just enough to control the gram-positive bacteria, we can then set up a better environment for the yeast to grow faster, be more vital and actually produce alcohol faster. We control bacteria, so yeast can dominate. 

Producers pleased with results

In the past six months, BetaTec has had good commercial success with IsoStab in the U.S. ethanol industry, Popa says. The company is coming out with customer proof statements detailing how the product has been effective for a number of plants. “We’re seeing that where this product is working best is in corn mash that is resistant to virginiacins,” Popa says.

In fact, experts say new antibiotic-resistant bacteria are emerging, something Popa and others are experiencing first-hand. “A year ago, we didn’t know about the resistance issue,” Popa says. “We’re just now collecting data on it, and it has been very interesting. Just about every mash sample I’ve pulled in the last six or seven months has a virginiacin-, penicillin- or amoxicillin-resistant organism in it.”

Several U.S. ethanol producers are now using IsoStab daily and reportedly benefiting from it. “The producers we are working with are seeing an increase in alcohol production with less corn usage,” Popa says, adding that producers using IsoStab are also seeing fluctuations in ethanol yield tightening up. “Scientifically, we can’t say exactly why this is happening, but we have done yeast vitality studies, and it does seem that the yeast grow better in the hops material than they do in mash by itself or in mash with antibiotics. For lack of a better way to describe it, the yeast are simply happier.”

While IsoStab can replace the use of antibiotics altogether, Popa says it is generally used as part of a control regiment that might include antibiotics. “We’ve seen good results with that, where the bacteria won’t adjust to any one environment,” he says. “Every week or so, you change that environment so [bacteria] can’t adapt.”

Even though BetaTec’s introduction of IsoStab is still relatively novel, the company is wasting no time developing its next line of all-natural fermentation products. “I think IsoStab is an excellent product—certainly a great first product to have on the ethanol market—but we’re going to develop several new products and introduce them over the next 12 to 18 months,” Popa says. “We’d like to have a couple of all-natural products besides the hops-based materials that can be used in ethanol production.”

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