Nicolas Cantacuzene: Efficacy of Gaseous and Aqueous Ozone in Treating Oak Used inWinemaking for Brettanomyces

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Nicolas Cantacuzene is a Master of Science Candidate at the California State University, Fresno in Food Science with an emphasis in Enology. Nicolas is a French citizen who started his degree in Pharmacy but decided to pursue studies in chemistry. Likehis parents, he attended the University of Paris V. He completed his B.S. in Chemistry at Sonoma State University (2000).Nicolas has been working closely with Dr. Erin Dormedy and Dr. Joe Smilanick using ozone to control Brettanomyces in oak. He has worked in several wineries as a lab assistant and plans to become a winemaker one of these days.

ABSTRACT: This experiment evaluated the efficacy of ozone as a sanitizer in the treatment of Brettanomyces found in oak cubes. The wine industry uses oak barrels to enhance flavor, favor wine structure and promote slow incursion of oxygen into the wine. During storage of wine in barrels, sediments deposit and form a layer of nutrient that favors the growth of undesirable microorganisms. Brettanomyces can proliferate in the sediment layer and produces an unwanted compound, 4-ethyl phenol, which is associated with a “band-aid aroma.” This yeast also possesses a ß-glycosidase capable of breaking down the hemi-cellulose found in wood. Thus, its population can be found on the surface and in the pores of the wood. We compared the efficiency of ozone with a commonly used sanitizer: hot water. Because hot water is energy demanding and has the potential to denature flavor compounds found in barrels, wineries have looked at alternatives for sanitation.

We used aqueous and gaseous ozone to treat oak cubes, which were used during this experiment due to the difficulty of determining Brettanomyces populations in oak barrels. An initial wine broth was spiked with a culture of Brettanomyces and oak cubes were introduced. Different concentrations of ozone and times of treatment were used. The efficacy of ozone was measured by determining the population of Brettanomyces in oak cubes before and after the treatments.

Breweries

Today, the world beer market amounts to some 35 billion gallons per year. About 5 percent of all beer produced in the U.S. these days comes from a new class of breweries called microbreweries. About 800 microbreweries in the U.S. account for about 300 million gallons of beer production each year. The central process that occurs during the production of beer, whether ale or lager, is the conversion of an aqueous solution of sugars extracted from cereals to an aqueous solution of ethanol. The sugar solution, known as wort, is a nutrient medium for yeast cells. During the fermentation process, the yeast cell population increases by feeding on the sugars. At the same time, the yeast excretes ethanol, carbon dioxide, and, in smaller amounts, other fermentation products.

Four distinct processes are involved in beer production: malting, mashing, boiling, and fermenting. After fermentation, the yeast is separated by skimming, bottom cropping, or centrifugation. Many raw “green” beers, particularly lagers and North American ales, are then stored or aged in a tank for several weeks at low temperatures. This allows the flavor to mature and haze-forming proteins to precipitate out. The beer is finally clarified by filtration, carbonated, and packed into kegs, bottles, or cans.

Solid-liquid separation occurs both upstream in the separation of the wort from the spent grain and removal of the hops after boiling, and also downstream to make bright, clarified beer. The development of crossflow filtration using ceramic membranes to clarify beer has been a major part of the Brewing Research Foundation International process innovation program in recent times. The conventional method for producing bright beers uses filter aids such as diatomaceous earth, also known as kieselguhr, to clarify beer. Some beers, such as traditional British ales, are not filtered at all.

Tangential flow filtration (TFF) is a relatively new process for beer recovery from fermentation yeast and tank bottoms. The first production size plant was installed several years ago and many installations are now in successful operation.

Schenk Filterbau states that beer recovery from spent yeast with tangential flow filtration using ceramic membranes is part of the process technology of the today’s modern brewery. Ceramic membranes made of highly pure alpha-aluminum oxide have proven to be the most suitable with respect to
reliability, membrane life and beer quality. Cleaning with all detergents at high temperatures is possible with the exception of phosphoric acid. The modular design of the TFF-plant gives high flexibility to any brewery size and for later extension of the plant with increased investment cost.

The brewery process presents one of the biggest challenges possible to a microbiological control program. Microorganisms are responsible for both the production and the degradation of the product. Microbiological control is critical for production and filling equipment.

Process chemicals used in breweries include chemicals for:

Foam control
Clarification aids
Microbiological control
Thickeners
Scale control agents
Cleaners
Fining agents

Breweries use high volumes of fresh water. For every one barrel of beer produced, 10 barrels of water are used. Consequently, water treatment is critical. Many of the most critical problems brewery plant managers face are system inefficiencies that can cause process problems, downtime and poor product quality. Treatment of the boilers, cooling towers, water preparation, wastewater and the most important phase of the brewing operation, the pasteurization process, are necessary. Chemicals prevent microbial growth, scale, corrosion and "dome staining" or rust rings from forming on beer cans as they pass through the pasteurizing tunnel.

Breweries have numerous vessels that are used to pasteurize, heat and cool their products. Organic loading from broken containers and the warm temperature in these systems create ideal conditions for the growth of microorganisms and bio-film. Applying chlorine dioxide to obtain a residual between 0.5- and 1.0-ppm immediately controls free-floating (planktonic) microorganisms, and over 48 hours, will control attached (sessile) microorganisms. Typically a 5-ppm dosage, based upon the re-circulation rate, is more than enough to obtain these residual levels.