Clean Technology for the Wine Industry

By Bob Smith-McCollum

The global market for wine is expanding dramatically, and this growth is expected to continue through the current decade. According to Vinexpo's 10th global study of current trends in the International Wine and Spirits Market and Outlook to 2010, worldwide consumption of wine is predicted to increase 6.2% between 2004 and 2009. The value of the global wine market is predicted to increase 10.9% over the same period, driven by much faster revenue growth in the premium wine segments.

Many wineries turn to ozone

Not surprisingly, as wine volume increases and infrastructure expands, process quality control and winery sanitation practices come to the forefront of ensuring product excellence at every step.

As with any food processing practice, sanitation in winemaking is of the utmost importance. When one barrel of wine represents $30,000 or more in revenue, sanitization becomes critically important.

Chief concerns in the wine industry are cross-contamination between batches of wine and management of Brettanomyces (natural yeast). Contamination with Brettanomyces yeasts spoils wine by rendering an off-flavor described by winemakers as "burnt plastic," "leathery" or "wet wool" tastes. In wine, these yeasts typically grow in low cell numbers after completion of the alcoholic and malolactic fermentation during aging of wine in barrels and bottles.

Winery Sanitation Practices

In the past, standard sanitation practices included the use of chlorinated cleaners for sanitation of winery equipment,

followed by a citric acid rinse to neutralize the chlorine. Barrel sanitation was an even tougher challenge; chlorinated cleaners could not be used in barrels because of the porous properties of oak and possible chemical retention. After the wines were pumped out, barrels would receive a low-pressure water rinse using a rotating spray ball to flush out the lees (fermentation sediment) and tartrate (crystal precipitate).

Today, winery sanitation practices are much different. The link between chlorine and TCA (2,4,6-trichloroanisole—a cause of odorous cork taint) caused many wineries to switch to non-chlorinated cleaners for daily sanitation of winery equipment and tanks. The use of ozonated water for sanitation was presented about 10 years ago and was quickly adopted by the wine industry.

Ozone offers higher sanitization quality, time and energy savings and decreased chemical use. Natural ozone gas, which is produced safely and economically through sophisticated, yet easy-to-use integrated ozone generation and contact systems, is the world's most powerful commercially available disinfectant. Ozone kills microbes up to 5,000 times faster than weaker oxidizers like chlorine but decomposes naturally in its oxidation-reduction reactions to elemental oxygen—without the harmful disinfection byproducts of harsher agents.

In California's Napa and Sonoma valleys, more than 500 ozone generators are in use today. Many wineries utilize convenient, portable cart-based ozone systems. Increasingly, wineries are choosing to have ozone available on tap at various key locations in both white and red wine facilities. These building-wide centralized ozone systems are the trend of the future and serve as a foundation for broader and more creative ozone solutions.

Typical applications for ozone in the wine industry include: barrel washing, surface and equipment sanitization, tank cleaning, and clean-in-place (CIP) of process and transfer piping.

Barrel Washing

In light of ozone's sanitizing power, many wineries have implemented ozone as part of their barrel-washing practices. Standard procedure for barrel washing varies from winery to winery but typically includes a high-pressure hot water rinse followed by an ozonated water treatment. The concentration of ozone applied, as well as the contact reaction time in the barrels, depends on the quantity and nature of the contaminant. Larger quantities of microbes in contaminated barrels require longer treatments, but smaller doses may be required to handle sensitive materials. Typically, a 2.5 ppm ozone concentration for two minutes on healthy barrels after a hot-water flush is sufficient. If the barrel is severely contaminated, a five-minute treatment may be required.

This treatment process does not damage the interior or reduce the useful life of the barrel, which might result from the use of harsh chemicals. Ozone enhances the barrels by preventing organic buildup that undercuts the longevity of these precious vessels.

Furthermore, chemical analysis of oak volatiles, which contribute to wine flavor, shows the use of ozone is a good alternative sanitizing agent for oak wine barrels. No significant effect on volatile recovery was observed at ozone concentrations currently used at wineries.

Ozone washing of wine barrels saves wineries considerable money on the high costs of replacing contaminated wine barrels. Before using ozone, wineries typically replaced a significant percentage of these barrels every year due to contamination and regular deterioration. Ozone treatment reduces barrel spoilage loss, thus reducing overhead costs and increasing production flexibility. It is also interesting to note that in the secondhand barrel market, ozone-sanitized oak barrels command higher prices than those cleaned traditionally. As a result, most ozone installations have a high return on investment and short break-even period.

Surface & Equipment Sanitization

A broad range of surfaces and equipment are routinely sanitized with ozonated water to control unwanted microbes and cross-contamination. Harvest bins, crushing and destemming machines, conveyors, bottles, bottling equipment and even floors are routinely and effectively sanitized using ozone.

Tank Cleaning

The effectiveness and versatility of ozone have expanded beyond barrel washing and sanitization in recent years. While ozone is still the nonchlorinated cleaner of choice for initial sanitation, experience shows it should also be used for additional follow-up rinses as well. Stainless steel tanks may stand empty for a week or more after initial sanitization. Many wineries rinse all stainless steel vessels with ozonated water immediately prior to filling in order to ensure proper sanitization.

CIP of Piping

The biggest threat to winemaking is contamination during the long production process—from harvest to tank to barrel to final bottling. The highest risk comes

from transferring the wine between the many necessary tank and barrel treatment steps that gradually create the unique blend of flavors sought in a fine bottle of wine. To mitigate this risk, wineries adopt stringent measures to their CIP processes.

CIP involves cleaning and sanitizing pump systems, pipes, tanks, hoses, filters and bottling lines. Using soaps, detergents, pressurized water and chemicals such as chlorine or iodaphore solutions, these cleaning steps can require multiple rinses—often with hot water or steam—to remove residues. This labor- and energy-intensive process is also a worker safety concern and can consume up to 10 gal of water for each gallon of wine produced.

Ozone—already an integral part of CIP sanitization in the food processing industry—is a natural choice for wine process machines. Using ozone in the CIP process saves time as well as costs. Ozonated water is circulated through the piping systems and reacts with organic material.

For absolute sanitization, most systems are designed to re-circulate according to preset dissolved ozone levels using proportional-integral-derivative control. Many modern ozone generators have these types of controls built into their standard control panels, which receive signals from ozone sensors connected in the pipes or tanks and allow machinery to be cleaned and sanitized easily and automatically.

Safety: Off-Gas & System Control

An important consideration when applying ozone is the issue of off-gas. When ozone gas is added to a water stream, there will never be 100% retention of the ozone microbubbles. Changes in fluid pressure and temperature will affect the solubility of ozone gas and cause some ozone to escape into the ambient environment. Most of this concern is resolved with mass transfer technology and well engineered contact and degassing systems; however, when applying ozonated water to surfaces, some ozone gas will be released.

When a leading Napa Valley winery first introduced ozone for barrel washing, little off-gassing was detected. Because the opening in the barrel is so small, off-gas is trapped in the barrel and dissipates naturally. This winery's experience has shown that the off-gas ozone in a wine barrel actually improves barrel sanitization since the gas is able to penetrate where water cannot.

Today, ozone is accepted as an industry standard around the world. Winemaking requires chemicals for some of its processes and cleaning, but ozone can be a natural alternative to many of the harsh chemicals used to grow and process our world's food products. *wqp*

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