

## **Sanitation for the nation – ozone in the winery**

**By Ruby Andrew**

Ask a New Zealand winemaker about ozone, and you're liable to hear about sunburned grapes and a "hole" in the atmosphere. Yet ozone has been employed as a disinfectant for more than a century, typically in municipal water supplies, swimming pools, and sewage treatment plants. It was only in 1997, however, that ozone was recognised in the United States as being safe for food processing: since then, US wineries have eagerly adopted its use as an efficient and highly effective means of sanitising everything from winery work surfaces to tanks and barrels to bottling lines.

Most of us already know what ozone smells like: O<sub>3</sub> is that fresh clean scent in the air that comes after a thunderstorm. It's created when oxygen (O<sub>2</sub>) and electricity interact, which is why the smell is often evident around copy machines, electric motors, and arc welders.

In nature, ozone levels range from 0.01 ppm (parts per million) to 0.15 ppm, although concentrations can reach higher levels in urban areas. Ozone is also a highly reactive substance: it doesn't last long (its half life is just 10 to 20 minutes), because its third oxygen atom is transferred to any organic compound it touches, causing the gas to revert back to the oxygen from which it was generated.

As a sanitising agent, ozone is used in higher concentrations, typically ranging anywhere from about 2.0 to 10.0 ppm. The amount required is determined by "concentration and time" for each application. In other words, as the ozone concentration gets higher, the time required to produce an acceptable microbial kill rate goes down.

At these levels, contact with ozone instantly kills enzymes, microbial membranes and unpleasant taste- and odour-causing compounds. Ozone destroys all known bacteria, virus, molds spores, yeast, mildew, microscopic fungi and biofilms (colonies of microorganisms that cling to surfaces).

Given ozone's effectiveness as a sanitiser, it's not surprising that winemakers are becoming keen proponents of its use – particularly in terms of keeping *Brettanomyces* at bay. Today, small portable ozone generators are a commonplace sight at many wineries in California's Napa Valley.

The generators produce ozonated water that can be sprayed directly on floors, drains, walls, destemmer-crushers, tanks (interiors and exteriors), fruit bins, barrels, and just about anything else, provided it's a non-rubber, non-fibreglass piece of equipment or surface. Usually, surfaces are first cleaned, and then ozonated water is used as a final rinse.

Where ozone really comes into its own is with repeated use. Easier and environmentally friendlier than frequent use of chemicals or heat, ozone sanitising is cumulative in effect – the more you use it, the cleaner the winery equipment will be.

As word of its efficacy has spread, a few New Zealand winemakers have also begun to experiment with ozone systems. Doug Wisor, the winemaker at Craggy Range, is one of them (given that he originally hails from California, perhaps that's not too surprising). Wisor had the luxury of building a new winery from scratch, and right from the start he knew that ozone was going to play a big role in the operation.

"We actually designed this winery around the use of ozonated water for sanitation," he explains. "And so that had an impact on our technical specifications, such as the polymers and stainless steel used in equipment."

Wisor initially looked to the States for his ozone generator – with mixed results. "We did our research and purchased a portable unit from a reputable California manufacturer," he says. "But maintenance became an ongoing problem, and the cost of the circuit boards and electrical units required for replacement is fairly high."

Ozone generators, he notes, are actually rather delicate. They run into difficulty in environments subject to high humidity and/or situations where frequent bumps can occur. "A generator will take more than a couple of hard knocks as it's wheeled over the bumpy surfaces in a winery, and we ended up blowing a few circuit boards," he adds. "Then we discovered that servicing can be difficult with an overseas supplier."

Wisor's experience is not unique in this regard. Although servicing may be less of a pain when you're not separated from your supplier by the Pacific Ocean, the fact remains that ozone systems require regular maintenance and monitoring in order to work as they should.

There's another reason why monitoring is so essential: ozone is a toxic gas, with standards in place for exposure to it in the workplace. At the higher concentrations required to kill microbes, ozone off-gasses into ambient air, and care must be taken to monitor the level of ozone exposure over time. New Zealand, like many other countries, sets the maximum human exposure to ambient ozone at 0.1 ppm over an extended (8 hour) period. It's worth noting, however, that in more than 100 years of industrial use, there has never been a human death attributed to overexposure to ozone.

Workers require safety training on the correct use of ozone equipment, and, if a system is to remain effective, the ozone concentration and flow rates must be checked on a regular basis. All ozone generated should be accounted for, by checking for leaks in the system and by proper destruction of any excess gas.

A useful article on the subject can be found on the website for *Practical Winery*, an American magazine. (See the accompanying box, "Recommended Reading," for a short list of additional resources available on the Internet.) Written by Dr. Brian Hampson, a professor of food science at California Polytechnic State University, the article emphasises that if ozone is dissolved in water that is subsequently used for sanitation, there is always going to be some excess ozone that will not be dissolved:

"No ozone mass transfer system is 100% efficient. Excess ozone ... must be 'degassed' or separated from the water stream prior to delivery to equipment or the

processing environment. This excess ozone must also be destroyed or decomposed back to oxygen before being released back into the atmosphere.”

Hampson also underlines one of the key factors in making ozone work in the winery:

“It is not enough to just purchase an ozone generator. Your winery must also have maintenance, verification of performance, monitoring, and, especially in the case of mobile ozone units, an in-place systems approach that ensure the safe use of ozone in the workplace. Properly used, these ozone sanitising systems are much safer than chemical (chlorine and caustics) or heat-based sanitising systems.”

At Craggy Range’s Highway 50 winery in Hawkes Bay (profiled in the November 2003 issue of this magazine), the elements outlined by Hampson are now firmly in place. Wisor’s frustration with the delays and costs involved with his overseas supplier eventually led him to explore what the domestic market could offer. The search led him to Dirk Hasselhof, director of Ozone Technologies Ltd., in nearby Napier.

Hasselhof’s company already had a sturdy track record: it’s been in business for 15 years, supplying ozone equipment to city water and wastewater treatment facilities, municipal swimming pools, and large-scale industry. Working with a winery was new to him, however, and he had some reservations about the company’s portable generator.

“We won’t supply portable systems,” he says. “Ozone generators are simply too delicate and they require a correct environment that’s stable and dry.”

After consulting with Wisor, Hasselhof proposed a stationary generator, located in the winery’s works area. The copyrighted unit will run a reticulated system that pumps ozonated water throughout the facility for use on demand from the service towers dotted throughout the winery. The system will run full time, and is automatically monitored to ensure that the water on return is still at the correct levels for sanitation.

Craggy Range will also use ozone, rather than hot water, for clean-in-place applications, such as on the winery’s newly installed bottling line. “This is the first ozonated bottling line the guys have built, but in terms of making sure the equipment can withstand the treatment, there’s only a very small cost increase over a traditional hot water system,” says Wisor. “It’s a million dollar unit, and you’re looking at only a few extra thousand dollars to use ozone.”

The contact time required for ozone to kill off all the organics is a mere 20 to 30 minutes for the entire bottling line – compared to two to three hours using heat sterilisation – and Wisor notes that the energy savings will soon pay for the additional installation costs.

Because each application has its own contact-time requirements, Wisor appreciates the full-time monitoring that’s part of the new system. But Craggy Range goes further, double checking everything fortnightly with a small kit similar to those used on home swimming pools, and also by taking swab tests on surfaces so that the company’s lab can test again for microbial levels.

“You can smell ozone at fairly low levels, and when you do smell it that generally means you’ve sanitised whatever piece of equipment you’re working on,” notes Wisor. “However, you need to constantly monitor your outputs and test equipment to ensure that you have killed the organics.”

Asked about ozone’s uses at Craggy Range, Wisor cites a very long list: the floors of tank and barrel rooms, drains (after any big procedure), catwalks, tanks, hoses, pumps, bins, punch-down tools, barrels, wooden tanks, and the destemmer. About the only thing that doesn’t come in for an ozone treatment is the company’s wine press, which requires chemical sanitisation.

That’s a lot of ozonated water going into the winery’s wastewater system, but Wisor points out that by the time the water from an application reaches the treatment system, it’s already been pumped into five different settling chambers over a number of days. “Ozone has a reaction time of minutes,” he explains, “so there’s no worry about the water killing off any beneficial microbes in the treatment system – as there would be if we were pumping the same amount of water that had been treated with chlorine or ammonia.”

At the moment, the wastewater is then treated chemically before being recycled to irrigate Craggy Range’s vineyards; eventually it, too, will be ozonated – virtually eliminating chemical disinfectants at the winery.

Because Craggy Range has decided to use ozone so extensively, Wisor trains all staff on its safe use as part of their orientation. “New employees have to read the information from the US Food and Drug Administration along with a number of other materials I’ve put together in a ‘FYI’ package,” says Wisor. “The main thing people have to know is that we can smell ozone long before it reaches dangerous levels in our immediate environment. If you can smell it before you finish the designated contact time for your particular application, you need to consider whether the reaction is, in fact, complete, or whether you should be doing the job in a more ventilated area – and that’s why monitoring is so crucial.”

Haselhoff says that Wisor’s training programme is exemplary. “It’s quite common for workers to be reluctant to use ozone, simply because they don’t know enough about it,” he adds. “But Doug is so thorough that his people understand how to use the equipment, the safety considerations, and so on. Ozone is a safe product, but without that sort of training and monitoring, you’re faced with people’s fear of the unknown.”

Wisor is equally complimentary about Haselhoff’s contribution to Craggy Range: “Dirk’s expertise is phenomenal. His professionalism is in a totally different league compared to anyone we’ve spoken to overseas.” And best of all, Wisor adds, “He’s not even a long-distance call away.”

## **Recommended Reading**

American winemakers are the world leaders when it comes to using ozone for sanitising equipment, so it makes sense that related American publications can offer valuable information on the topic. The following websites offer useful coverage for anyone interested in ozone use in the winery: