By Bob Smith-McCollum

bottling perfect water

Ozone dosing at final bottling is the most common application for ozone in the production of bottled water; however, ozone can be utilized in many other ways in the modern bottled water plant. The Water Guy, a Pennsylvania spring water company, provides a compelling case study for additional uses of ozone in bottled water.

Ozone applications in bottling spring water

The Water Guy, a brand of Shinn Spring Water Co., was founded in 1990 by brothers Bryan and Douglas Shinn. The company began as a distribution organization, selling water bottled by a major regional company. As the Shinn brothers gained more experience in the industry, they felt a greater need for control over product quality and packaging. This led them to develop two spring sources and build their own bottling plant.

In 2008, Shinn Spring Water completed the construction of a technologically advanced and fully automated bottling facility. The new plant integrates modern high-speed bottling equipment, upgraded electronic process and quality controls, enhanced quality assurance (QA) inspection, robotic material handling and a state-of-the-art onsite QA laboratory.

As an IBWA bottling member, The Water Guy has earned the association's prestigious "Excellence in Manufacturing" award and continues to improve its

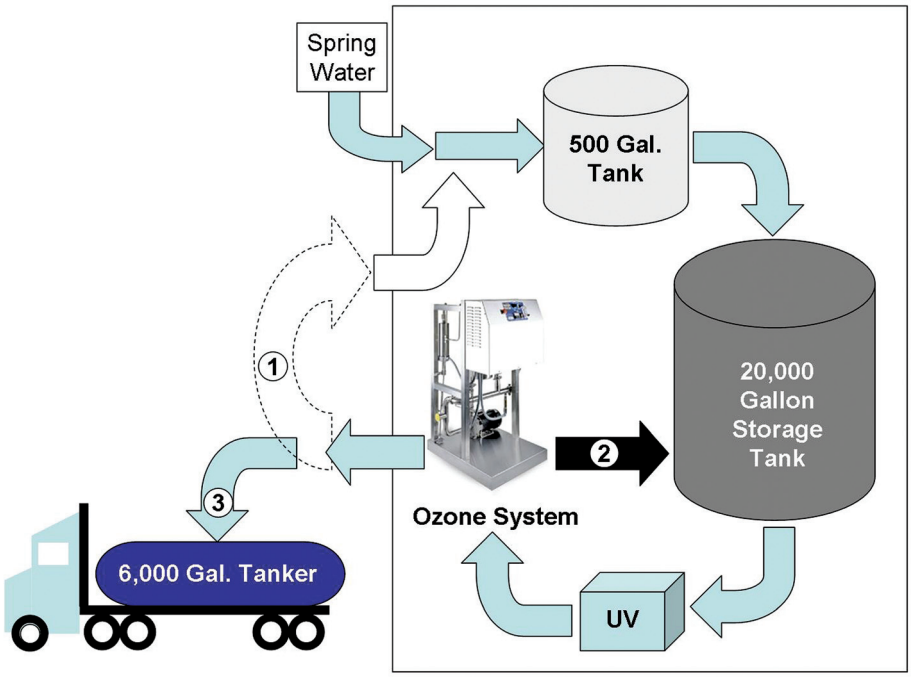

FIGURE 1. The system diagram for one of the spring sites.

facility and operations every year.

Today, the company's natural spring, purified, mineral-enhanced purified water and steam-distilled water are packaged in a variety of sizes including 8-, 16.9-, 20- and 24-oz. individual-size bottles as well as 1-, 3-, 4- and 5-gal bottles. The Water Guy provides home and office delivery (HOD) bottled water products to residential, commercial and wholesale customers, as well as filtration water coolers and office coffee service. The company's market area continues to grow with HOD service to 20 counties in Pennsylvania, Maryland, Delaware and New Jersey, serving more than 20,000 customers.

Ozone at the Spring Sites

The Water Guy operates two protected spring sites in the pastoral Pennsylvania countryside. The spring water is loaded into 6,000-gal tanker trucks and transported to the company's bottling facility in Birdsboro, Pa., centrally located less than 30 miles from both spring sites.

The Water Guy uses ozone in three ways at the spring sites: clean-in-place (CIP) of the water transfer piping, CIP of the spring site water storage tank and bio-control of the vented tank truck vessels. These sanitation procedures are performed at the spring sites monthly or sooner if indicated by the results of microbiological testing.

All sanitation protocols are designed to provide the highest levels of cleanliness and quality in the water collection and transport processes and to eliminate the use of sanitation chemicals. The latter point is important because the company has no municipal sewage connection at the remote spring sites.

The system diagram for one of the spring sites is shown in Figure 1. Ozone is provided by a Pacific Ozone ICS060 integrated ozone system, which produces 25 grams of ozone per minute at 350 gal per minute water flow. The skid-based system integrates the ozone generator with enhanced mass transfer and control subsystems.

CIP of Transfer Piping

The ozone generator combines an onboard air compressor and oxygen concentrator with an air-cooled ozone reactor cell making it an ideal choice for remote sites that do not have a compressed air source. The mass transfer system includes a venturi injector, tank-less fat pipe mass transfer system and an ozone destruct device. The control system utilizes a two-channel dissolved ozone detector and PLC controller to maintain the desired set point. An ambient ozone detector with system shutdown interlock ensures worker safety.

The CIP of the transfer piping is accomplished by forming a closed loop with a flexible hose at the tanker load out point. For sanitation, ozonated spring water at 400 ppb dissolved ozone is recirculated through the ozone system and piping loop until a residual level of 400 ppb is reached and maintained for 30 minutes. The ultraviolet (UV) system is switched off for this procedure.

CIP of Storage Tank

The CIP of the 20,000-gal stainless steel storage tank is accomplished in a similar fashion. Three-way valves are set to establish a loop between the ozone system and the storage tank.

Approximately 1,000 gal of spring water is recirculated through the ozone generator and returned through the tank's spray ball system until a residual level of 400 ppb is maintained for 30 minutes. The UV system is switched off for this procedure as well.

Tanker Loading

Biocontrol of vented tank truck vessels is accomplished by injecting ozone at 150 ppb into the spring water during filling. The residual ozone of the trucked water is checked on arrival at the bottling plant. The goal is for the load to arrive with at least 100 ppb residual ozone. Water samples are drawn from every delivery for microbiological testing as well as an assessment of physical factors including color, conductivity, pH, turbidity and taste. The test results show that applying ozone to the water during loading keeps the tankers very clean and safeguards the quality of the spring water.

Pacific Ozone ICS060 integrated ozone system.

Ozone in the Bottling Plant

The centralized bottling plant includes four separate ozone systems. One system maintains the quality of the sourcewater in the plant's storage silos, and another ozone system is dedicated to the bottle washing station. Two additional ozone systems are each dedicated to ozone dosing on the plant's two filling lines.

Water Storage

Water arriving from the spring sites is filtered (1 micron) as it is transferred to a 50,000-gal stainless steel storage silo.

The dissolved ozone of the stored water is monitored and maintained to ensure the quality of the stored water. The water is recirculated periodically through an ozone injection system powered by a Pacific Ozone SGC 11 ozone generator to maintain a low-residual dissolved ozone concentration of 100 ppb. Distilled water is produced onsite and maintained in a similar fashion in a 20,000-gal silo. The silos are co-located and serviced by the same ozone system.

Bottle Washing

Returnable 3- and 5-gal bottles are inspected and tested for leaks before undergoing rigorous cleaning in an automated bottle-washing station. The five-step process includes pre-wash and wash steps followed by three rinse steps. The first is a fast rinse with municipal water. The second rinse is a rigorous three-stage process that utilizes ozone-injected municipal water. Ozonated distilled water is used for the final sanitary rinse. The ozone concentration of the last two rinse steps is 400 ppb.

Bottling

The bottling plant contains two automated bottling lines housed in the same dual HEPA filtered filling room. The first bottling line is serviced by an IOCS-A22 ozone system with a 575-gal mass transfer tank. This system delivers product to the filling line at 100-gal-per-minute at 300 ppb dissolved ozone. Ozone dosing for the second filling line is provided by an Aquatyzer system powered by an SGA 24 generator with a 500-gal mass transfer tank that delivers product at 125 gal per minute.

The spring water receives a final filtration (0.45 micron absolute) and UV light disinfection before transfer to the ozone treatment then on to the filling lines. Distilled water is treated in a similar fashion. Municipal water is softened and filtered before steam distillation and then transferred to the 20,000-gal storage silo and ozonated as described above. At bottling, the distilled water is disinfected by UV light before final ozone dosing and filling.

Integrated Ozone Systems

All of the ozone systems in The Water Guy facilities integrate all four of the critical elements of ozone systems: feed gas preparation, ozone generation, mass transfer and monitoring and control. All four elements must be incorporated and optimized to form fully functional ozone systems.

The majority of The Water Guy ozone systems are pre-engineered, skid-based systems. Such systems are pre-configured to the needs of each application to ensure smooth operation and optimal results. The utilization of integrated ozone skid systems alleviates The Water Guy personnel of the responsibility of being ozone experts and allows them to focus on their water business.

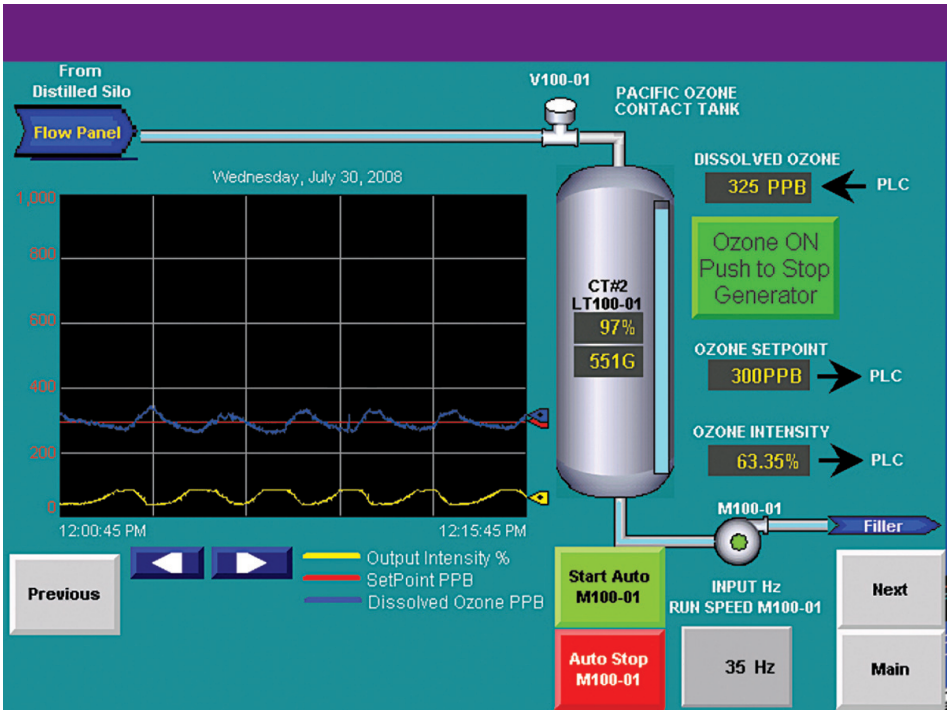

FIGURE 2. A graphical display for controlling the distilled water ozone system.

Process Control is Key

The Water Guy is fortunate to have access to very good source water. Their spring water has very low total dissolved solids and pH. Bromide conversion is minimized by the excellent quality and chemical composition of the sourcewater in conjunction with closely monitored process controls.

Even with great source material, Bryan Shinn emphasized that monitoring and control of all processes is the key to maintaining excellent quality. "Mother nature makes our spring water perfect," said Shinn, "and our process and quality control ensures that it gets to the customer that way."

Monitoring and control were at the heart of The Water Guy plant design from the planning stages. The spring sites and bottling plant include multiple monitoring points for dissolved ozone, water flow and other critical process parameters. In addition, each facility includes a master control system, designed by Atlas Automation, which integrates the process inputs and provides precise process control for consistent quality.

The control system of the bottling plant utilizes an intuitive graphical human-machine interface. The system collects system performance data from an array of sensors and provides graphs of recent trends in the data. Figure 2 shows an example of a display screen for the distilled water filling line. The system collects and graphs the set point and actual dissolved ozone concentration as well as the ozone generator intensity control value. The latter adjusts the voltage applied to the ozone reactor cell, which in turn controls the ozone output of the ozone generator.

"Manual hourly checks are great and necessary," said Shinn, "but a lot can happen in an hour that will go unnoticed without ongoing critical process monitoring and controls."

A Bright Future

The Shinn brothers have big plans for The Water Guy business, including additional plant expansion and continued improvements. Their well-planned and developed spring sites and bottling plant demonstrate the value of thorough planning and disciplined execution. The Water Guy operations also demonstrate the many important roles for ozone in the modern bottled water facility. *bw*

Bob Smith-McCollum is vice president of marketing for Pacific Ozone. Smith-McCollum can be reached at 707.747.9600 or by e-mail at bsm@pacificozone.com.