Ozone use in the bottled water industry

An efficient disinfectant, ozone also keeps water tasting fresh.

By John Swancarra

Ozone treatment of bottled water has been an important process in the bottled water industry for approximately 30 years. Ozone has provided an efficient, safe method of disinfecting water against water-borne microorganisms or other bacteria that may be present in the final water, the bottling equipment and the final filled bottles and caps.

The process requires careful, precise operation and quality equipment to ensure that bottled water is properly disinfected and tastes good through its shelf life.

The best system for introducing ozone into the final bottled water product depends on many factors, including:

- Size of the operation;
- Type of water to be treated;
- Level of ozone required; and
- Current or proposed bottling equipment.

The process

The bottled water industry uses several methods of introducing ozone into the product water before bottling:

- Batch processing;
- Inline atmospheric contacting; and
- Inline pressure contacting.

Each type has its benefits and weaknesses, and choosing the right method can prevent many potential problems.

To be safe and effective, ozone must be injected correctly.

Batch processing

The batch processing method starts by ozonating a large storage tank until the desired ozone level is reached.

Two possible methods of tank ozonating include:

1. Using a small circulation pump, a small ozone generator and Venturi injector to create and entrain the ozone gas into the water stream flowing into the tank;

2. "Bubbling" the ozone into the tank water with a diffusion stone.

When the desired ozone level is reached, a separate pump delivers the ozonated water to the filling operation. The tank is ozonated continually by whichever batch processing method is used to maintain an acceptable ozone level.

Batch processing is usually good for small bottling operations that do not require large amounts of processed water.

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Avoiding potential problems

Over-ozonation

To be safe and effective, ozone must be injected correctly. Over-ozonation of the water, for example, may lead to taste problems due to a high level of ozone (0.40 ppm or more) and reactions with the plastic in the plant piping, and even with the bottle itself.

Sometimes, in the non-returnable market, too much ozone or improperly injected ozone may allow some ozone to outgas into the air layer between the water and the cap. If this bottle is opened soon after bottling, the consumer may notice a metallic taste in the water caused by the ozone smell.

Bromide

The presence of bromide in some treated waters — especially spring or well water — has become a major concern in recent years. Bromate, a suspected carcinogen in levels as low as 10 ppb, is formed by oxidation of the bromide ion during the ozone disinfection process.

THMs

Final product water purified by reverse osmosis (RO) may cause problems with ozonation levels if the RO water still contains trihalomethanes (THMs). THMs are byproducts in municipal waters caused by the chlorination process and cannot be removed by RO.

THMs can be oxidized and removed by ozone treatment but by doing so, will use up the ozone and lower the residual levels of ozone in the final product water.

Testing for THMs in the feed water and removal by carbon filtration before or after the RO will prevent this problem and eliminate the need for a larger ozone system.

Many, if not all, of these benefits and drawbacks are related to the quality of the ozonation equipment and the ozonation method used.

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Inline atmospheric contacting

This ozonation method involves drawing the product water out of the storage tanks with a pump and delivering the water to a large atmospheric stainless steel contact tank. The water is then either ozonated by a Venturi injection assembly inline with the water flow or by ozone bubbling into the contact tank with a diffusion stone.

In the contact tank the water requires a specified length of contact time with the ozone to be treated effectively, and is then delivered directly to the bottle filler by a second pump.

This process is considered real time in that, as soon as the contact tank fills and both pumps are delivering water at the same flow rate, the bottle filler can operate continuously without waiting for the right ozone level to be achieved.

Many large bottled water companies currently use this form of ozonation. Having the appropriately sized contact tank is very important, especially if the ozone is bubbled into the tank.

This process may also require considerable fine-tuning to balance the pumps and generally requires an ozone monitor/controller unit to insure proper ozone levels.

Inline pressure contacting

This method of ozonation — also considered a real time system — can be handled in one of two ways:

1. One pump delivers the water from the storage tanks through a Venturi injection assembly with a large amount of bypass into a pressurized contact tank, then out to the bottle filler. A return line back from the filler to the storage tanks is required.

This technique is ideal for small bottling operations and for small fillers that do not require high pressures to fill. If sized correctly, an ozone monitor/controller may not be needed.

2. Two pumps are required. The main pump is used to draw the product water out of the storage tanks, push the water through the contact tank and into the filler. A smaller pump is needed to boost some of this pressurized water through a Venturi injector assembly to draw the correct amount of ozone into the water stream.

The two streams of water merge and mix together in the pressurized contact tank on their way to the filler.

This method, also called side-stream ozonation, is good for intermediate-

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What does ozone do?

Ozone (O_3) is an unstable, colorless gas, a powerful oxidizer and a potent germicide. It has much higher disinfection potential than chlorine and other disinfectants.

Once generated, it takes ozone just a short time to break apart and return to its natural form of oxygen. As this phenomenon occurs, the free atom of oxygen seeks out any foreign particles in the water and is attracted to them.

This action creates an environment where bacteria or organic matter virtually disintegrate when they come in contact with the free oxygen molecule, protecting water from waterborne bacterial contamination.

The variables determining the effectiveness of ozone in killing bacteria are contact time and residual ozone concentration achieved in the product water. This ozone concentration residual is first dependent on how much ozone is injected into the product water and then the amount of ozone demand in the water.

The ozone treatment provides longer store shelf life without the presence of unfavorable tastes and odors associated with untreated waters or waters utilizing chlorine for disinfection.

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sized bottling operations.

If sized correctly, an ozone monitor/controller may not be needed; however, it is best to have one to ensure that the correct level of ozone is supplied to the filler.

Ozone equipment and method

The following equipment is recommended to create ozone and to inject ozone into the product water:

Oxygen concentrator

A good pressure swing adsorption system is highly recommended. This equipment removes nitrogen from the air stream and delivers a 90 percent-plus dry oxygen stream to the ozone generator for higher ozone concentration.

Ozone generator

A good high-frequency corona discharge (CD) unit is recommended. These units are capable of producing ozone concentrations in the air stream from 4 to 6 percent by weight.

The ozone is created as the oxygen stream travels through the ozone generator's corona discharge dielectric cell. The proper electrical charge with the right frequency will create a high-quality ozone concentration.

Venturi injector

A properly sized Venturi-type injector is absolutely necessary to ensure the formation of small micro-sized bubbles as the ozonated stream of air is sucked into the product water stream. A well-designed assembly is capable of entraining the ozone into the water with an efficiency of 95 percent or better.

Contact tank

A properly sized contact tank is necessary to allow more gas into the solution, permit adequate contact time for the water with the ozone to oxidize contaminants, or disinfect the water and release any excess gas that did not go into the solution. □

Ozone treatment provides longer shelf life without unfavorable tastes and odors.

John Swancarra is an engineer with Norland International, Inc., Lincoln, NE. He has worked in the bottled water industry for over 20 years.