

Ozone extends seafood shelf-life

Nancy Griffin reports how ozonated water extends product shelf-life by destroying harmful bacteria in seafood processing plants



Bristol Seafoods says its business has grown steadily since ozone was installed, and that it uses it as an aggressive marketing tool

Before Bristol Seafood of Portland, Maine on the north east coast of the US, installed an ozonated water system, it called in an independent testing service to take baseline readings of bacteria levels in six crucial spots throughout the plant.

Five weeks later, after the new ozone system was turned on, the independent testers came back to take random

swabs of the same six spots in the plant.

'They called right after the second round of tests and said they wanted to come back again because something was wrong,' says Kevin Murphy, Bristol plant manager. 'They came back and did another test, and told us that, as it turned out, the first tests of the ozone system were right; they just didn't trust the results and thought their equipment had a problem.

'The bacteria counts had been reduced a thousand fold,' Murphy says. 'The counts were so low, they couldn't believe it until they did the tests a second time.'

Ozone has been used as a sterilising agent for more than half a century. For instance, ozonated water has been used in the citrus fruit industry for a long time to spray the outside skins of fruit before shipping to kill mould and fungus.

In 2001, the US Federal Drug Administration (FDA) approved ozone for use on raw proteins, including seafood.

Ozonated water has been used in the Bristol Seafood plant for nearly six years – in the plant's ice, for rinsing fish before and after cutting, for washing down surfaces (including trucks and the front of the building), in the air in some areas, and as a big marketing tool because of the extended shelf-life low bacterial levels give the product.

Proponents say ozone practically performs miracles. It reduces bacterial counts on work surfaces, and on raw product – thereby extending shelf-life by 'at least two days, usually more', says Murphy. While it doesn't replace scrub cleaning agents and water for the scrub down after processing, it replaces bleach as a rinse and sanitising agent – and with no side effects.

Ozone is merely 'three oxygen molecules stuck together' which makes it unstable, says Ray Swenton, president of Bristol Seafood. 'Oxygen likes to be at two molecules because it's stable at two. At three it will attach to something when it comes in contact with it, such as hydrogen, when it will become water – or carbon, when it will become carbon dioxide.'

Ozonated water is created by first extracting oxygen from the air by running it through a corona discharge unit, then exposing the oxygen to electricity to create ozone gas. The ozone gas is pumped into the water in a dedicated plumbing system.

'Bugs [harmful micro-organisms] can develop a resistance to chemicals,' Swenton says. 'Unlike chlorine, which is basically a salt, nothing can build up a resistance to ozone. When it comes in contact with bacteria, it kills them because it's unstable.'

Listeria destroyed

THE US has a 'zero tolerance' for listeria which is ubiquitous in nature



Kevin Murphy, plant manager of Bristol Seafood, Portland, Maine, setting the ozone machine. Different bacteria have different ozone levels recommended for their destruction

and difficult to control in fish processing plants.

'We tested a foam spray from Norway [to kill bacteria]. The inspectors loved it because of the drama, but we did laboratory tests comparing it to ozone, and the ozone surfaces were sterile. And, the foam didn't touch listeria,' says Peter Rubenstein, president of Pressure Techniques Inc, installer of Bristol's ozone system which was manufactured by ClearWater Tech LLC, of San Luis Obispo, California.

'Chemicals attack the DNA, the cell of the bacteria. Ozone explodes the cell wall. Ozone not only destroys listeria, but for some reason listeria is particularly sensitive to ozone.'

'It kills listeria before *E. coli*,' Rubenstein says. 'Of course, they're all killed in seconds anyway.'

So, why doesn't every seafood plant in the world, or at least in the US, have an ozone system?

Some processors may resist ozone because of the many myths that circulate about it.

One myth is that any off-gassing, or release of excess ozone into the air, is dangerous.

'What doesn't come out in the water, comes out as gas,' says Rubenstein. If ozone is in the air, the human nose can pick up the scent at as low as 40 parts per billion (ppb). It's the same smell that occurs after lightning strikes, creating ozone through the surge of electric energy reacting with the oxygen in the air.

'If there's too much, you'll smell it a mile away,' Rubenstein says.

There is little risk unless the amounts are excessive, there is no ventilation and leaks of the gas are so regular that workers' become desensitised and unable to smell it.

'This is where claims come in – separating one brand of machine from another – the efficiency of how the mixing of gas and water is done,' says Rubenstein. 'Hopefully the water comes out 100 per cent saturated.'

'Otherwise, some machines have an off-gas destruct unit. Ours doesn't have one because there's no off-gassing. That's the efficiency you're looking for.'



The ozone levels used for ozonated water in a seafood processing plant are small compared with the large scale use of ozone gas for treating large water systems, or in the bottled water industry. In fact, Bristol uses some ozone in the plant's air purposely. 'We use ozone air in the thawing unit and the ductwork in the lower room,' says Murphy.

'It reduces odours,' says Swenton. 'It's especially useful when dealing with waste.' Swenton also pipes ozonated air into his office as an air freshener.

A Santa Fe, New Mexico organization, Ecosensors, says ozone is often used as a treatment for indoor air quality through a building's heating and air conditioning system, in places such as hotels, casinos, restaurants and other public places, as well as homes.

Ozone in the air is considered completely safe if levels are kept below 0.05 parts per million (ppm). Ozone makes the air odour-free by eliminating the odours, not masking them.

Short payback

SOME potential users may balk at the upfront cost of installing an ozone system, but the payback time can be short. For Bristol, Swenton says payback was between two and three years.

When Bristol Seafood installed the first system nearly six years ago, chemical suppliers warned us we wouldn't be happy with it, says Swenton. 'We weren't, but it wasn't because of the ozone, it was because our first supplier wasn't "user friendly".'

Using ozone has cut chemical costs at Bristol from \$9000 a year to \$2000. The cost of additional electricity to run the quiet, 20 amp ozone equipment is minimal. 'It is like another small appliance running in the plant,' Swenton says, 'probably less than your refrigerator at home.'

'Then there's water, but we use that anyway,' says Murphy.

Annual maintenance averages between 2-3% of the machine's cost. Machines require some user maintenance, such as changing filters.

A dedicated plumbing system installed for Bristol's first system cost \$1200, says Murphy. A couple of years

later, when installing Rubenstein's system, a more extensive plumbing network added to provide 25 outlets – either taps or sprays – for the ozonated water covering 24,000sq feet (2230sq m) in the plant, cost \$6500.

Ozone machines cost from around \$20,000 to \$40,000 depending on the output. 'A bigger machine doesn't put out better ozone,' says Rubenstein.

'Ozone is ozone. Plumbing installation for a small plant could be as little as \$500 and a large one, \$10,000.'

Bristol's machine can produce 150 gallons (568 litres) a minute. Next door, the North Atlantic, Inc seafood processing plant has been using ozone for several years also, with a machine installed by Rubenstein that produces 60 gallons (227 litres) a minute.

'Ozone can be corrosive,' says Swenton. 'We invested in a high-end plumbing installation. It needs stainless steel or PVC.'

Ozone will attack natural rubber and Murphy says they were warned it would corrode latex seals. 'If it sits on latex gloves for long they'll disintegrate.'

Extended shelf-life

THE Bristol management says it can't say exactly how much its business has

increased due to the use of ozone, but it can say the business has grown steadily since ozone was installed, and that it uses it as an aggressive marketing tool.

'It's something we advertise,' says Swenton. 'We know it increases shelf-life for our customers and we promote that.'

'If we put treated and untreated products side by side, we can see two or three more days of shelf-life,' says Murphy. 'We can hit the fish with one spray of ozone before testing and the reading will say there's no bacteria.'

At North Atlantic, Jerry Knecht, president, says he uses ozonated water and ice for the same reason; it extends the shelf-life of his product for his customers, and 'it allows us to have a 99 per cent bacteria-free plant and a 99 per cent bacteria-free product with no residual compounds'.

Fresh (chilled) doesn't mean good quality, Swenton says, just that product has never been frozen. 'For some product, ozone is a stopgap measure.'

'If product that is less than superior gets through our screening process, ozone minimises its effect on other product. And, we can keep it from aging as quickly as it would. It doesn't make it better, but it keeps it from getting worse fast.'

'We want to be more cutting edge – a lot of people in the industry are selling the same product we do, so we try to differentiate. Shelf-life is one of the most important things you can do when selling raw product.'

'We tell the employees, we're not dealing with dead fish, we're dealing with food for someone's table.'

'"Shipsape and Bristol fashion" is the company's motto and that means we want to do everything the best we can, in sanitation as in everything else,' Swenton adds. 'Ozone minimises mistakes.'

'Unfortunately with ozone, every benefit is unseen, but every one is quantifiable,' says Murphy.

Many uses

OZONE is nearly ubiquitous in the bottled water industry, large public water and wastewater treatment systems, swimming pools and aquariums. Ozone in different forms is also used in wildly different industries,

such as growing plants, to providing a healthier environment for raising farm animals, and cleaning semiconductors.

Paper mills are starting to use ozone in place of chlorine, thereby eliminating the production of dioxin. Many experiments are being performed in the medical and dental fields as well.

Ozone gas is a sanitiser often used to treat vegetables by injecting the gas into a closed container to kill bacteria, for instance on potatoes.

Fishing boats, especially those Bristol Seafood buys from out of Honolulu are getting an extra few days by using ozone ice. 'It keeps the ice machine clean, too,' Rubenstein says.

Ozone systems are becoming more sophisticated and less fragile. 'We can put them in wet areas now. They used to need a completely dry area. I wouldn't put the hose on them though,' says Rubenstein.

Research has found ozone enhances or at least strengthens the flavour of some foods. In Japan, it's used in the making of noodles. In Chicago, a manufacturer uses it in sauces.

'In blind taste tests, 97 per cent of the time people choose the ozonated product as better tasting,' says Murphy. 'It won't add flavour where none exists, but it will enhance flavour.'

Different mindset

SWENTON and Murphy say Bristol employees have adopted a different mindset since the advent of ozone in the plant. Now they routinely rinse out a tray or a recyclable tote before reuse, knowing they can eliminate the bacteria.

Truckers at the plant have taken to washing out their trucks with ozonated water, and employees hose down the front of the building, near the loading docks.

'You can also sanitize without removing the product,' Rubenstein says. 'The sanitation guy can just come through and sanitize while the others [workers] are on break.'

'There's no toxicity in the water,' says Murphy. 'You can drink it.'

Murphy and Swenton aren't just talking up the plant's investment. They bring the ozone home.

Murphy has two ozone machines in his home, while Swenton has an ozone machine at his summer cottage. 'We pump the water from the lake, ozonate it and drink it,' he says.

Both Swenton and Murphy believe the use of ozone reduces absenteeism because there are fewer bacteria to infect employees with diseases.

Different bacteria have different ozone levels recommended for their destruction, and the machines can be set for different levels. An ozone spray has a life of four seconds, so a spray needs to make contact immediately in order to work effectively.

Alaska wouldn't allow ozone to be used in plants in the state at first, says Murphy. 'It was so new, they didn't really know about. But since they learned, they now endorse it.'

Health Canada 'hasn't made up its mind,' Rubenstein says. They allow it but only at a minimal level. 'I'm uncomfortable with that, because if there's a glitch in the water, you lose the effectiveness.'



Kevin Murphy (left), plant manager, and Peter Rubenstein, president, Pressure Techniques, Inc, Haverhill, Mass with the ClearWater ozone machine in the Bristol Seafood processing plant