

# Safeguarding the Spa Industry From Legionella Risks

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Hot tubs and spas can create ideal breeding conditions for Legionella, so manufacturers must provide effective bacteria control systems.

Recent news reports tying a Legionnaires disease outbreak to hot tubs at a North Carolina fair, demonstrate that hot tubs are regularly being linked to deadly pneumonia epidemics in the public eye. The spa-based outbreaks are global — the first documented case of Legionella bacteria spread to the public from a hot tub occurred in 1999 at a Dutch flower show, and other outbreaks have been recorded in Australia and the U.K. — but they aren't common. In fact, people are much, much more likely to encounter Legionnaires disease from a nearby cooling tower or commercial air conditioning system than

from a hot tub or spa.

Still, everyone in the spa industry has to take Legionella seriously and work hard to control it, because if one were to design a breeding system for Legionella bacteria, it would look an awful lot like a hot tub.

## At Home in the Tub

Legionella is a genus of bacteria that thrives in warm water, particularly at temperatures between 68 and 122 degrees Fahrenheit. It is often sheltered beneath protective layers of scum and biofilm, or hidden inside the bodies of amoebas. Loose in the water, Legionella can travel into people's lungs in tiny droplets of mist or steam, causing severe pneumonia that leads to 8,000 to 18,000 hospitalizations annually in the U.S. alone. Legionnaires disease, which is caused by Legionella, has an alarmingly high fatality rate of about 1 in 10 patients, especially among the elderly and people with lung disease or compromised

immune systems. The bacteria can also cause Pontiac fever, a less serious disease that results in fever and muscle aches, but not pneumonia.

## **Multistage Approach**

Many articles about Legionella jump immediately to disinfection — using chlorine or bromine to disable germs, including Legionella, by stopping their metabolism. However, chlorine and bromine fight an uphill battle as they try to tackle Legionella.

First, only about 2.5% of the chlorine and 7.5% of the bromine added to spa water actually accomplishes any disinfection, according to *Water Conditioning + Purification* magazine. The rest is bound up oxidizing other molecules — and there are plenty of other substances in most hot tubs, from user-introduced bacteria and bodily fluids to products like shampoo, lotion and perfume that wash off into the water.

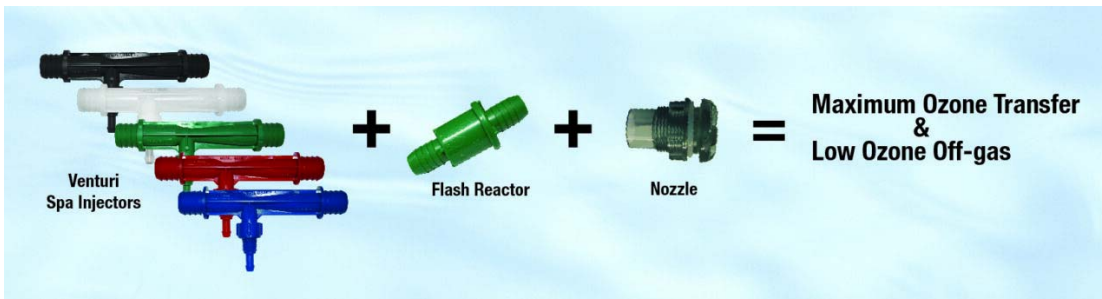
Bacteria and oily beauty products also contribute to the formation of biofilm in the hot tub and its plumbing. Beneath the outer layer of the film, Legionella can breed and multiply. Unfortunately, disinfectants do not penetrate or destroy biofilm, so the Legionella within the scum is largely safe from their effects.

As a result, many hot tub and spa manufacturers inject ozone into the water. Ozone is a highly active oxidizer that ruptures bacteria cell walls and destroys other organic materials, including biofilm, through rapid oxidation. After ozone destroys biofilm and kills off most of the Legionella, disinfectants can clean up the rest.

## **Effective Ozone Contacting**

Ozone is a gas, so incorporating it into spa water and getting it into contact with target pathogens requires finesse. The sweet smell of ozone is an early indicator that a system isn't working — if the ozone is in the air where you can smell it, it isn't in the water blasting away bacteria. Stray ozone can also attack tub surfaces, prematurely age hot tub covers and damage the lungs of people who breathe it in.

It is important to adjust ozone rates to meet the need of the tub. Too much gas in relation to liquid volume prevents good mass transfer, and the excess can float away, increasing cost and causing damage. Just as important as the gas-to-liquid ratio — actually more important — is ensuring that the ozone is injected and mixed properly. One of the most effective ways to inject ozone into water is through a carefully designed venturi injector.



A combination of well-designed venturi injectors, flash reactor and nozzles draws ozone into spa water and mixes it thoroughly so the oxidizing agent can attack biofilm and kill bacteria.

A venturi injector in a hot tub forces a pressurized water stream through a conical restricting chamber, then allows it to expand in a second cone, creating a vacuum that draws in ozone and mixes it with the water. In the most efficient systems, the ozonated water then flows through a flash reactor, whose carefully designed and placed baffles shear the remaining gas and provide thorough mixing in just a few inches of line.

There are no moving parts in a venturi injector, but exacting engineering, precision manufacturing and high-quality materials are vital for maximizing its effects. The precise shapes and dimensions of both chambers in the venturi impact the effectiveness of the injector; high-quality materials help ensure that chemical and physical wear don't alter the chambers. The best-made injectors, coupled with precision nozzles and a well-designed flash reactor, can achieve mass transfer rates in excess of 90%. That puts a lot of oxidizing power into the water where it belongs. Lower-quality injectors and nozzles are not nearly as effective.

## All Surfaces

Once ozone is in the water, it is short-lived but highly effective. Spa recirculating systems transfer ozonated water through the plumbing and tub to attack biofilm, pathogens and other contaminants in pipes, tubes and the tub itself. That leaves few bacteria to multiply and little shelter where they can breed.

When manufacturers install effective ozonation systems in their spas and hot tubs, they can avoid headlines, protect the industry's reputation, and allow customers to truly relax, instead of worrying about Legionella.

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