

What is ozone?

- Ozone is "active oxygen", nature's special molecule (an ozone molecule consists of three oxygen atoms).
- Ozone is created in nature either by the combination of oxygen in the air and ultraviolet rays or by the electrical discharge during a lightning storm.
- There is a small amount of ozone in the air we breathe.
- Ozone is a natural purifier (meaning no harmful chemical by-products are created during purification).
- Ozone has a clean, fresh scent noticed after a rainstorm.
- Ozone is the most powerful oxidizer that is safely used in a whirlpool, spa or swimming pool.
- Ozone is the alternative water sanitizer to traditional spa and swimming pool chemicals such as chlorine and bromine.

Where is ozone used?

- Ozone is used in a wide variety of industries worldwide.
- Ozone has been used in municipal water systems, wastewater plants and commercial & residential pools and spas for years.
- Ozone is used in water parks, zoos and aquariums.
- Ozone can safely be used on food equipment surfaces during the manufacture of food products.
- Ozone is used to remove offensive odours from fires and other smells.
- Ozone is used as the final purification step in most bottled water plants.
- Ozone is used for dental treatments.
- Ozone is used for skin treatments.

Ozone is not new technology!

- Ozone was first discovered by Schönbein in the 1840's when he discovered a unique odour during electrolysis and electrical sparking experiments. He recognized the odour as the same odour observed after a lightning flash. He named the substance "ozone" after the Greek word "ozein", which means "to smell".
- Ozone has been used since the turn of the century to purify drinking and municipal waste water.
- In 1906, the city of Nice, located in France, built the first water purification plant to utilize ozone.
- Los Angeles, California, has one of the largest municipal ozone water treatment plants in the world. Ozone has been used for 65+ years to purify pool and spa water worldwide.
- Since 1984, all Olympic Games Competition pools have been purified with ozone.

How does ozone work?

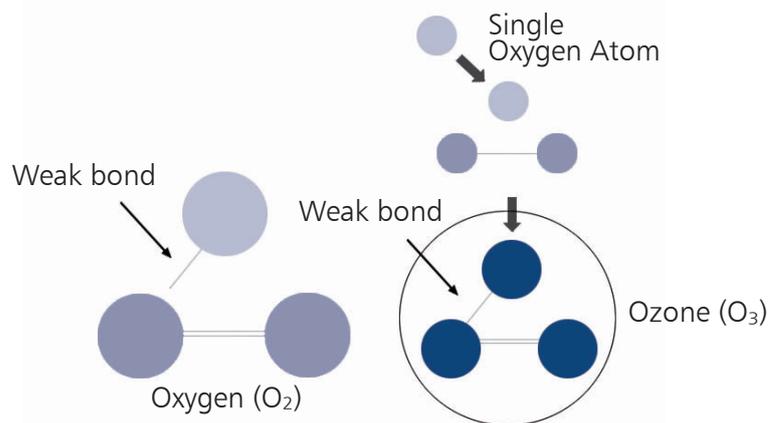
Ozone can be artificially produced, so that it can be used for water sanitation. Ozonators create ozone artificially by means of extremely high voltages or by means of UV-light. Both methods involve the decomposition of the oxygen molecule (O_2). E.g. when a ultraviolet (UV) radiation hits an oxygen molecule, it may cause the molecule to break apart into single atoms of oxygen ($O_2 + UV \rightarrow O + O$). These atoms are very reactive, and a single oxygen atom can combine with an oxygen molecule to form ozone ($O_2 + O \rightarrow O_3$).

The weak bond holding ozone's third oxygen atom is what causes the molecule to be unstable and thus, very effective.

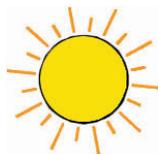
An oxidation reaction occurs upon any collision between an ozone molecule and a molecule of an oxidizable substance (i.e. bacteria, fungi, mould, viruses...)

When a ozone molecule collides with an oxidizable substance, the molecule will release its third oxygen atom. The atom then attaches itself, not to another oxygen molecule, but instead to the oxidizable substance.

No ozone will be left in the water.



Ozone production technologies



Ultraviolet (UV) Light - light energy

This is how ozone is produced in the upper atmosphere via UV rays of the sun..

UV ozonators:

- Use a UV lamp to produce ozone

A special UV lamp gives off a specific frequency instantly converting oxygen (O_2) molecules into ozone (O_2 -active oxygen molecules) inside the ozonator.



Corona Discharge Chip (CD) - electrical energy

This is how ozone is produced in the lower atmosphere via lightning.

CD ozonators:

- Use a CD electrode to produce ozone

Oxygen (O_2) passes through an air gap between a high voltage electrode and a stainless steel grounding electrode. The "energy field of electrons" created by the high voltage electrode instantly converts oxygen (O_2) molecules into ozone (O_3).

Ozone features and benefits in whirlpools and spas

- Ozone is the most powerful oxidizer and disinfectant which can safely be used in whirlpools and spas.
 - Ozone is the alternative water sanitizer to traditional chemicals such as chlorine and bromine.
 - Ozone kills bacteria 3,000+ times faster than chlorine and bromine.
 - Ozone will not burn eyes or leave them red and irritated.
 - Ozone will not irritate or dry out skin.
 - Ozone will not leave a chemical film on material or skin.
 - Ozone will not discolour or damage hair or clothing.
 - Ozone eliminates disease-causing micro-organisms.
 - Ozone does not have to be purchased or stored. Ozone is generated on-site and is introduced into the water automatically.
 - Ozone does not affect the pH balance in the water, thus minimizing pH adjustments.
 - Ozone eliminates much of the routine maintenance because it does such an effective job of keeping the water clean. It does so by oxidizing oils and other oxidizable substances (e.g. bathing oils, lotions), which helps prevent the greasy edge around the whirlpool and spa forming. It actually removes particles from the water (moving it closer to its natural state) without having to add more chemicals.
 - Ozone makes chlorine work more effeciently.
 - In the quantities needed for water purification, ozone does not irritate humans or equipment.
 - Ozone leaves no by-products. In contrast, chlorine leaves a chemical by-product called hypochloric acid and additional salts in water applications.
 - Ozone and chlorine work perfectly together: Ozone is a constant oxidizer that destroys organics and microorganisms very effectively, but only when in contact with water. You will still need to keep a very low residual level of chlorine in the water.
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The effect on different materials!

Chlorine alone in the quantities needed to keep the water clean, will be very aggressive on most materials, but when combined with ozone, the quantity needed is so reduced that the chlorine attack on the different materials will become minimal.

Ozone is generally also considered very aggressive on most materials. However when dissolved in water the concentrations typically used are extremely low and thus the effect of ozone minimal to insignificant.

When injecting ozone into the tub through a separate jet the concentration passing through the jet wallfitting will be so high that the material used should be considered. E.g. a chrome-plated brass wallfitting will not be the optimal material. If chrome finish is requested / demanded, a chrome-plated ABS wallfitting would instead be more capable of resistance towards both chlorine and ozone.

What is the right level of ozone?

Ozone is in the air we breathe. The occupational exposure levels for ozone vary across the world. In many European countries there is an eight hour time weighted average exposure limit of 0.1 ppm, while in the U.S.A the comparable level is 0.08ppm. The World Health Organisation has an average Air Quality Guide-line of 0.05 - 0.06ppm measured over an eight hour period. According to EU regulations an average exposure limit of 0.3ppm for max. 15 minutes is allowed.

This means that the HydroAir ozonators, at the recommended air flowrate, must not exceed 0.1 ppm above the water surface in order not to create any health risks.

Ozone (O₃) rapidly reverts back to oxygen (O₂). As a result of this natural decomposition back to oxygen the use of an ozonator in a whirlpool or spa will not lead to a continuous build up of ozone. The level of ozone will stabilise at a predetermined level depending on variables such as room size, air changes, temperature, bacterias in the bath etc.

Test of HydroAir ozonators

In the following we will briefly describe our test process for the HydroAir Whirlpool Ozonator with Corona Discharge chip:

Installation

- Average corner tub
- 6 jet ring system
- Ozone is added via separate jet very low in a tub.
- Air speed – 2 ltr./m
- Clean tap water with no added chemicals

Released ozone is measured 10 cm above the water surface.

Measuring equipment used: aeroQUAL, series 500.

The amount of released ozone does not exceed 0.1 ppm.

Additional tests with various doses of salt, shampoo and oil have been carried out.

The ozone immediately attacks these substances.

The break down time of the substances will vary depending on the amount and type of substance. **The amount of released ozone does not exceed 0.1 ppm.**

