Indoor Air Purifier / -Sanitizer / -Disinfectant

What is Ozone?

Ozone (chemical symbol O_3) is a naturally occurring compound. Ozone is nature's strongest sanitizer and air purifier. Oxygen molecules (O_2) are converted to ozone (O_3) by either a high-voltage electrical charge (such as from lightning), or by ultraviolet light (such as from the sun rays) that splits the oxygen molecules into individual single oxygen molecules (O_1) which then recombine to form the ozone molecule (O_3). Ozone is produced in human cells as part of the body's defence mechanism (*Wentworth P, et al, 2002, Babior BM, et al, 2003, Peng KJ, et al, 2006*).

How does Ozone purify the air?

One radical oxygen atom (O_1) detaches itself from the ozone molecule (O_3), and reacts when it comes in to contact with a contaminant (dust-, mite fesus particles, spores, pathogens, bacteria, viruses, microbial- and/or general pollutants). Ozone is highly reactive, so it never fails to initiate this reaction. There is scientific research to show that ozone reduces air-borne infections**.** (*Jakab GJ, Hmieleski RR , 1988, Wolcott JA, et al, 1982*).

As the second most powerful oxidant in existence known to man, this single radical atom "oxidises" the contaminants it reacts with. This means it destroys the contaminants, by changing its physical properties (molecular structure); in most cases, to carbon dioxide and hydrogen. As a result, the contaminant is no longer toxic or able to reproduce itself if of bacterial, fungal or viral in nature; the particle becomes completely harmless. Any residual ozone reverts back to pure oxygen, making it environmentally friendly.

Is Ozone Safe?

Ozone sterilisation has become the treatment of choice for drinking water supplies world wide, is used in the production of canned/bottled drinks, and has been used in waste water management since the late 19th Century (*Dickermann et al 1954*). Ozone is more efficient than chlorine for water purification. Giardia and Cryptosporidium cysts are susceptible to ozone but are unaffected by normal levels of chlorine in water. Ozone is 25 times more effective than hypochlorous acid, 2,500 times more effective than hypochlorite, and 5,000 times more than chloramine. (*Results measured by the time needed to kill 99.99% of all micro-organisms*). Any unreacted ozone simply breaks down into oxygen. In comparison, chlorine reacts with organic materials to form chloroform, carbon tetrachloride, etc, generally known as trihalomethanes. Trihalomethanes have been implicated as the carcinogens found in the development of kidney, bladder and colon cancer. Ozone

is non carcinogenic. In the USA, the FDA and EPA certify ozone as able to destroy 99.9992% of all pathogenic germs in the purification of water whilst destroying 99.9992% of pollutants in the water simultaneously.

Ozone has been used to clean public air supplies since the early 1900's; for example, the London Underground Railway system was ozone-treated to prevent air-born infections as far back as 1912.

European research has shown that ozone can eliminate biofilms in water pipes (*Abu-Naba'A L et al, 2002, Struchkov A.A et al 2004*.) Struchkof described infection control with the use of ozone gas in a hospital burn unit. Burn trauma victims are susceptible to infection. By treating the whole treatment area, the burn trauma unit was effectively sterilised and no infection was seen with multiple-resistant micro-organisms.

Sterilisation with ozone gas is effective against all bacteria, viruses and fungi; prions show no resistance to ozone and the first commercial ozone steriliser has been in operation for the last 15 years in Canada.

Bacteria are microscopically small, single-cell creatures having a primitive structure. The bacteria body is sealed by a relatively solid-cell membrane. Their vital processes are controlled by a complex enzymatic system. Ozone oxidises the outer membrane, leading to immediate rupture and death of the cell. There is no known resistance to ozone due to the immediate and high kill-rate.

Viruses are small, independent particles, built of crystals and macromolecules, unlike bacteria, they multiply only within a host cell. Ozone destroys viruses by diffusing through the protein coat into the nucleic acid core, resulting in damage of the viral RNA. At higher concentrations, ozone destroys the capsid or exterior protein shell by oxidation within milliseconds of contact.

In virions which lack a lipid envelope but whose nucleic acids are surrounded by a protein capsid such as those of the minovirus family, ozone may diffuse through the protein coating and deform or cleave the genome core. Viruses, unlike cells, lack enzymes designed to repair injured DNA or RNA, and are incapacitated by this process. (*Wells K, et al, 1991*).

The United States Refrigeration Service Engineers Society has reported that electric-arc welders exposed to ozone levels of 0.2 to 0.3 ppm for a decade showed no adverse effects. According to the 1961 Encyclopaedia of Chemical Technology, "During the 80-year history of the large scale usage of ozone, there has never been a human death attributed to it." To this day, there has still never been a single human death or incident of harm attributed to ozone. This despite the fact that ozone was widely used in hospitals during the first half of the 20th century, and is still widely used in European hospitals. In addition, millions of ozone air purification systems are in use worldwide, both commercially and residentially. Ozone has not been found to be harmful to human lungs until administering concentrations as high as 0.1 – 0.2 ppm. However, it is very difficult (if not impossible) to adjust commercial ozone air purifiers to produce anywhere close to this amount of ozone. At proper levels (0.02 ppm to 0.05 ppm), ozone will have a pleasant and clean smell to it, reminiscent of the natural smell after a lightening storm.

In a Cuban study by *Mapolón Y, Recio E, et al. 2004,* 168,310 subjects (children and adults) treated with ozone from July 1992 till December 2003 were followed. The clinical results were excellent, with no side effects. A great deal is known about the tissue reparative mechanisms and immune system response by humans when exposed to ozone gas.

Why install Ozone Equipment?

Since ozone dissipates quickly (within 15 minutes at room temperature), ozone equipment must be used on-site to be effective. The main medium for transfer of dust-, mite fesus particles, pathogens, bacteria, viruses, microbial- and/or pollutants is air. There is no known more effective solution for sterilising and/or sanitisation of air in hospitals than ozone.

Patients are carriers of bacteria and can cross-infect healthy individuals. Bacteria from nasal and mouth cavities when coughing, talking or even breathing float around, stuck to microscopic drops of saliva. Bacteria can also spread from open and bandaged wounds. These airborne bacteria come to rest on patient's hands, personnel and furniture for example, acting as a starting point for further infections. Ozone is a known disinfectant that can prevent potential cross infections and/or cross contamination. Ozone is also the ideal medium to keep all surface areas aseptic due to its known sterilization properties.

A recent paper from Taiwan, (*Chih-Shan L and Yu-Chun W, 2006*) examined the surface germicidal effects of ozone for microorganisms. It concluded that low ozone concentrations and time exposures eliminated all bacteria and fungal infections.

We live in an era of bacterial strains that are resistant to most antibiotics, of a population that has a decreased ability to fight infection and who are compromised by traumatic injury, pre-existing infection and immuno-suppressants. Any system capable of preventing air-born cross infection should be a high priority for public areas, especially in areas where susceptible members of the community gather for heath care. Health authorities wanting to reduce their potential for legal action where inadequate cross infection control leads to hazardous conditions for patients, visitors and workers can use ozone technologies to control and minimise this risk.

Apart from its disinfecting and sterilization properties, ozone has a strong deodorising effect. As ozone is released, it reacts with all organic compounds by breaking them down. Odour is generally caused by the decay of organic compounds. Ozone removes odour by oxidising this organic material and removing the source that actually creates the odour. Ozone destroys bacteria, mould, mildew and even oxidises odorous gasses like smoke and volatile sulphur compounds (*Holmes J, 2002*). It is important to note that ozone's deodorising action is not simply a masking effect of unpleasant odours like volatile sulphurs; it is a true chemical destruction of the compounds that create the odours in the first instance.

How much Ozone is required to be effective?

In studies conducted at the Academy of Medical Sciences in Russia, (*Malysheva AG, et al, 2006*) 0.005 ppm to 0.02 ppm of ozone added to normal indoor air (0 ppm) increased animals' resistance to infections, toxic substances, and to oxygen deprivation. A general increase in the immune "biological potential" and the vital capacity of the lungs was reported.

The same study showed concentrations of ozone of less than .01 ppm in an air-conditioned office buildings, lead to elevated blood oxygenation. And a decrease in complaints of ear nose and throat infections (3.8 times fewer complaints). The study concluded "Atmospheric ozone has a positive effect on animals and people. It is important to note its positive effect on the respiratory system, blood composition, arterial pressure, immune system, general feeling of well-being and mental and physical work capability. The ozone-ion complex is a necessary component of fresh air that gives it a curative effect."

Russian scientists performed a study to see how effective ozone was at improving indoor air quality

in schools (*Gubernskii IuD et al, 1978*). Respiratory-related illnesses were drastically improved after the ozone systems were installed. The ozone concentration produced by the system was 0.015 ppm. This study has been repeated in the USA (*Jakab GJ & Hmieleski RR, 1988*). Laboratory tests have shown that ozone effectively destroys bacteria at 0.04 ppm.

Many publications have published studies showing the effectiveness of lower concentrations of ozone (0.01 to 0.03 ppm) at removing odours and pollutants. Some of these include the United States Refrigeration Service Engineers Society (USRSES), U.S. Air Force technical publications, and Manufacturing Chemist.

Summary;

Ozone as a treatment for air:

- Kills bacteria, airborne viruses
- Destroys dust-, mite fesus particles, spores, airborne pathogens and microbial contaminants
- Removes odours and allergy causing pollen and microbes
- Prevents mould and mildew, the leading cause of Legionnaires Disease (A 1999 study conducted at the University of Minnesota found that both ozonated air and water inactivate mould, rendering the mould cells harmless).
- Eliminates toxic fumes
- Is Safe and non carcinogenic
- Disinfect / sterilize contaminated surface areas
- Ozone also tends to deter insects.

The Indoor Ozone Unit

Features

- Utilizes low voltage (220V mains to 12VDC adapter) for general safety purposes
- Ozone producing reactor manufactures from high quality quartz glass and 316 surgical stainless steel
- Ozone output adjustable by means of a microprocessor controlled interval timer (adjusting table will be provided in operating manual according to air volume; either area (m^2) or volume (m^3)
- Visual indication when unit produces ozone
- Low maintenance

Benefits

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Technical Specifications

Input Voltage	85 to 250VAC (universal switch mode adapter)
Power Consumption	≤10W
Ozone Output	0.05ppm$_{max}$ at room temperature
Visual Indication	Produce Ozone: Blue LED
Adjustment	On Time: 0 to 60 minutes
	Off Time: 0 to 60 minutes
Enclosure	Wall mountable impact proof coated abs plastic
Size	(H) ±200mm X (W) ±120mm X (D) ±80mm
Weight	570g

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