OZONE ULTRA CLEAN

Introduction.

Welcome

This information pack will introduce you to an innovative sanitising method that uses advanced technology to safely sanitise both air and surface areas using Ozone.

Why Use Ozone?

Currently, almost all sanitisation is performed using Chlorine based or similar chemical detergents. Whilst the current system is relatively effective, it is often labour intensive and complete coverage of all surfaces cannot be easily achieved. Chemical fogging can overcome the latter disadvantage, but can still become problematic on vertical surfaces and with some textiles.

Ozone is a highly effective sanitising agent for a number of reasons. It very quickly destroys any organic matter it comes into contact with and easily reaches into places that cannot normally be accessed. As it is a gas composed entirely of Oxygen it performs equally on all surface orientations and leaves no chemical residue to dispose of.

Ozone can be used to treat air and surfaces in combat against multiple organisms such as:

Bacteria and Viruses, e.g.

- Listeria Monocytogenes
- NORA Virus
- Listeria
- Salmonella
- Cold & Influenza
- M. R. S. A.
- E-Coli 0157:H7
- Pseudomonas Aeruginosa
- Staphylococcus Aureus
- Clostridium Botulinum

Protein Based Allergens, e.g.

- Dust Mites
- Pet Dander
- Yeasts
- Pollen
- Moulds
- Fungus

See the Appendix for a more expansive list

Deodorisation

As a result of its killing action on organic contaminants, Ozone is unmatched as a deodorising agent. Rather than simply masking odours with fragrance, Ozone deodorises by destroying the source of the odour. This results in long term odour removal, and leaves problem areas smelling of fresh, clean air.

This pack will provide you with the following information:

- How Ozone Sanitisation Works
- Frequently Asked Questions
- Appendix (Biocidal Efficacy)

We hope you find the pack to be a practical and informative resource.

How Ozone Sanitisation Works.

What is Ozone?

Most people have heard of ozone in the context of the ozone layer - the layer of our atmosphere that protects us from the sun's harmful UV rays. Ozone (O^3, a gas composed of three oxygen atoms) is naturally generated when atmospheric oxygen rises to the stratosphere, and is exposed to the sun's ultraviolet rays.

In addition to forming a layer of protection, ozone is one of the most powerful naturally occurring sterilisers in the world, destroying bacteria, viruses, allergens, mould and odours on contact (see appendix).

Naturally occurring ozone continually cleanses our air and water, effectively purifying the planet.

Ozone is a chemically reactive gas. This simply means that it 'attacks' other chemicals. Ozone kills bacteria, viruses and other organic matter it comes into contact with by rupturing the cell walls. This occurs when the extra oxygen atom breaks free, destroying the offending organism through oxidation. The very nature of Ozone's killing action means that contaminants are incapable of developing a resistance to it over time.

Although Ozone is very powerful, it has a very short life cycle, so when the extra atom breaks free and oxidisation occurs – Ozone (O^3) automatically reverts back into Oxygen (O^2) over time.

Ozone Sanitisation

Ozone's sterilising properties have been utilised for many years in the water industry, and more recently in the laundry sector for the decontamination of fabrics. New pioneering technology has now enabled us to safely utilise Ozone in gaseous form as a sanitising agent, opening up a world of possibilities for an innovative new approach to sanitisation.

By using our advanced equipment it is possible to convert the Oxygen (O^2) present in atmospheric air into Ozone (O^3). Our machinery can generate and sustain Ozone at biocidal levels, creating a very fast and efficient air and surface sanitisation.

By raising indoor atmospheric Ozone concentration, it is possible to completely sanitise any given area, as the additional Oxygen atom in the generated Ozone oxidises and kills:

- **Odours**
- **Bacteria**
- **Viruses**
- **Allergens**
- **Mould – Fungus**

The Sanitisation Process

Once the equipment is set up the operator leaves the area and starts the sanitisation process remotely. The Ozone diffuses into the area and engulfs all exposed surfaces and penetrates hidden areas and fabric items.

The Ozone rich atmosphere is sustained for a short period of time, typically under an hour, during which time bacteria and other unwanted elements are destroyed.

When the sanitisation process is complete, Ozone reverts back into Oxygen. This is further accelerated by an Ozone deactivation programme, so the process can be completed very quickly.

Advantages of using Ozone

Imagine the possibilities created by safely harnessing the sanitising power of ozone in gaseous form. As a gas, ozone is at its most effective.

Ozone gas can fill areas very quickly, will penetrate into places that are traditionally difficult to reach (including fabrics and upholstery) and will inactivate contaminants on contact.

Consider the labour force, time and range of chemicals required to disinfect the entirety of a large room and its contents.

By using ozone instead, all of the walls, the doors and doorframes, the windows, the floor, the ceiling, the contents, soft furnishings and even the air can be treated automatically, with no additional chemicals and in a very short timescale.

With traditional sanitising methods there is a risk of re-contamination as contaminates can potentially be spread around the area on cleaning cloths and implements. This risk is completely negated by using Ozone Sanitisation.

As Ozone is a gas composed entirely of Oxygen, it leaves no chemical residue whatsoever.

At the end of the sanitisation process, the only by-product remaining is fresh clean air. When compared to traditional chemical sanitising agents, Ozone would therefore seem the *natural choice* for any organisation looking to reduce the environmental footprint, time and labour requirement of their current sanitisation processes.

Frequently Asked Questions.

Is Ozone sanitisation safe?

The simple answer is Yes – when performed by a trained operator, Ozone sanitisation is completely safe.

The sanitisation process requires that the area for treatment is unoccupied and any potential leakage points are identified and adequately sealed. It is completely safe to use Ozone in an unoccupied, sealed area, as long as you wait until the ozone changes back to Oxygen prior to reoccupation.

Ozone naturally reverts back to Oxygen over time. This reversion can be accelerated using our (Patent Pending) ozone destruct feature. Therefore while high levels of Ozone are toxic, within a short time all of the Ozone will have literally disappeared.

The sanitisation process leaves behind no chemical residue, just fresh clean air! When compared to chemical germicides, pesticides, bactericides, fungicides or even simple air fresheners – Ozone is a much cleaner, safer option.

How long does the Ozone remain in the area after sanitisation?

Using our advanced equipment it is completely safe to reoccupy the area at the end of a treatment cycle. This is possible as a result of the following factors:

As soon as Ozone is generated and dispersed in a room it begins to change back into Oxygen. This occurs automatically due to Ozone's natural chemical instability. Ozone has a very short half life, which means that it will revert to Oxygen within a short timescale, in amounts equal to half its level.

The natural reversion process is accelerated further by the presence of contaminants, pests, allergens and even by general items within a room (furniture, fabrics etc), as the Oxidation reaction consumes the extra atom within Ozone.

Our machinery is equipped to perform a, ozone destruct system which massively accelerates the transformation back into Oxygen. The destruct system brings Ozone levels down to a point equivalent to the air just after a heavy downpour of rain. This allows for reoccupation of the treated area in a very short time scale, usually within minutes.

Is Ozone sanitisation environmentally friendly?

High levels of Ozone are highly toxic to organic matter – this is the principle behind our sanitisation process and exactly why Ozone sanitisation works.

However, Ozone used in the sanitisation process is completely confined to the area under treatment. As stated above Ozone is made up entirely of Oxygen atoms and will naturally turn back into to Oxygen once the sanitisation process is completed. There are no chemical production or transportation costs to consider, as Ozone is generated from atmospheric air on site. In fact, apart from the manufacturing and transportation of the equipment, the only energy cost to consider is the electricity used to power the machine.

When compared to traditional chemical sanitisers or even simple air fresheners – Ozone is a much cleaner, safer option – and is a superior solution for anyone wishing to reduce their environmental footprint.

How does Ozone reduce allergens?

An allergen is a substance that causes an allergic reaction. The majority of indoor allergens contain a protein - that is, the part of a living organism that includes hydrogen, oxygen and nitrogen. From our perspective this is very important, as this protein (and hence the allergen) can be destroyed by Ozone oxidisation.

Indoor air quality is often as much as 20 times more polluted than the air outside. Common indoor allergens are dust mites, mould spores, pet dander, pollen, and tobacco smoke. The prevalence of these allergens in indoor environments has increased dramatically in western society due to advances in the way we build and insulate our properties.

With our advanced equipment, it is possible eliminate any protein based allergen that comes into contact with Ozone.

When used at scheduled regular intervals, Ozone sanitisation can allay the accumulation of allergens in any indoor environment - providing a significant improvement to the quality of life of those affected by indoor allergies.

Frequently Asked Questions.

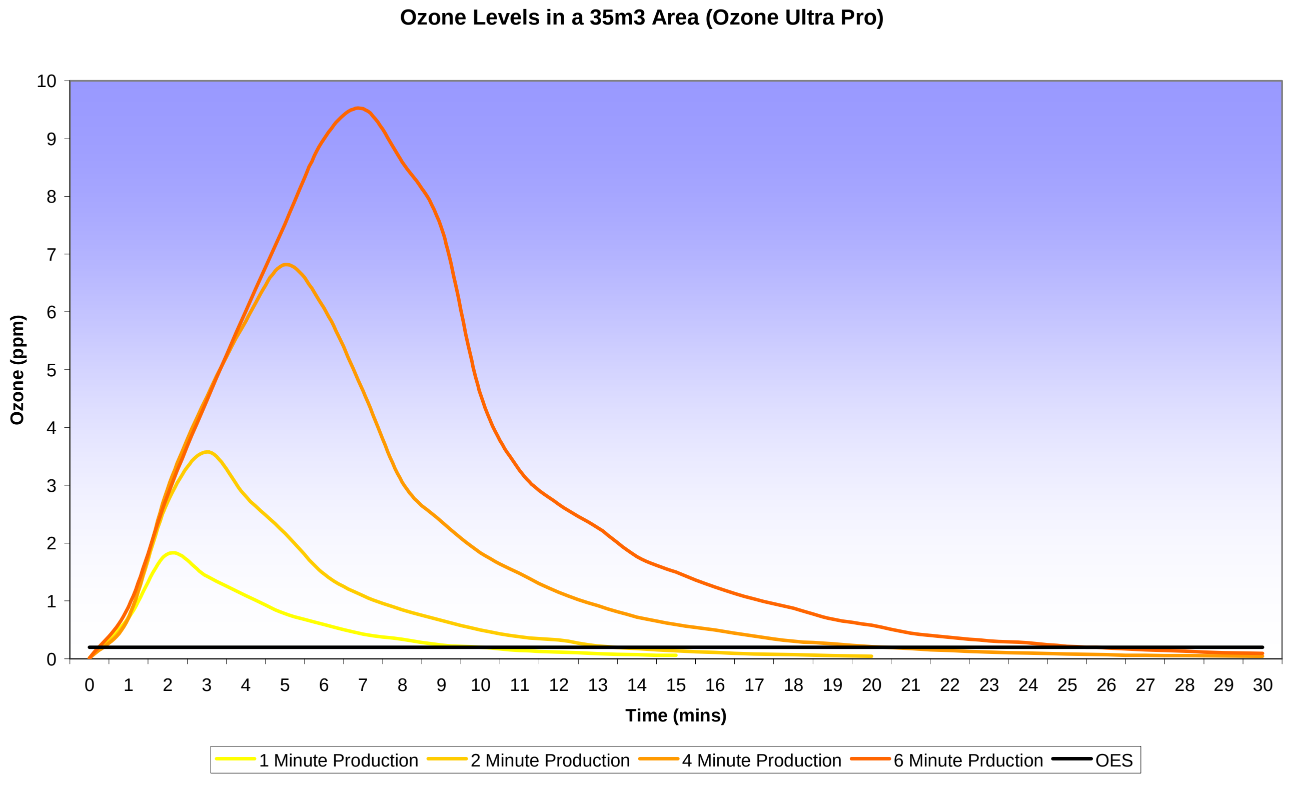
(Continued…)

What Health & Safety measures do you employ?

The use of Ozone gas comes under the HSE's guideline EH38. Ozone Ultra Clean takes every precaution necessary to ensure compliance with the current legislation.

The Occupational Exposure Standard (OES) for Ozone is currently 0.2 ppm over 15 minutes. Our ozone system, the *Ozone Ultra Pro* is designed to produce Ozone at a rate of 10 g/h allowing it to generate Ozone at very high levels, so we take the issue of Health and Safety very seriously.

The *Ozone Ultra Pro* is designed to ensure that upon completion of a treatment cycle, Ozone levels are returned to a level below the current OES. As you can see from the graph below, with 6 minutes of ozone production in a 35m³ area the Ultra Pro can produce Ozone levels up to almost 10 ppm (>2 ppm is generally considered to be highly biocidal). By the end of a 30 minute treatment cycle the deactivation phase returns Ozone levels back down to within Health & Safety requirements, leaving the area safe for immediate reoccupation.

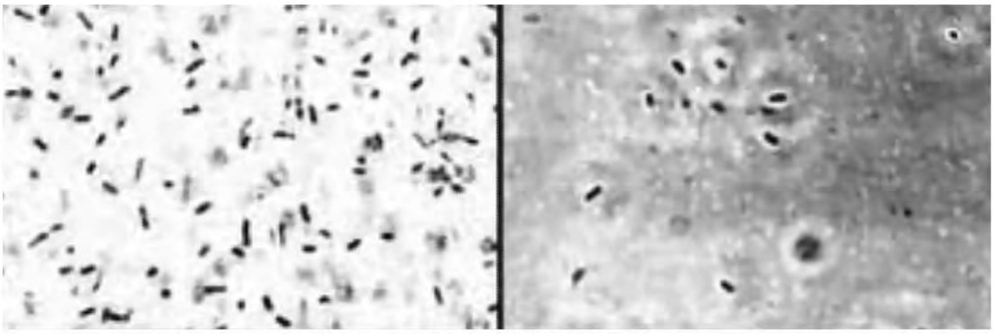


APPENDIX

INFORMATION ABOUT OZONE AND BIOCIDAL EFFICACY

Ozone action on bacterial spores viewed
under an electron microscope

Ecoli 0157:H7 exposed to 0.3 ppm dissolved ozone for 15 seconds



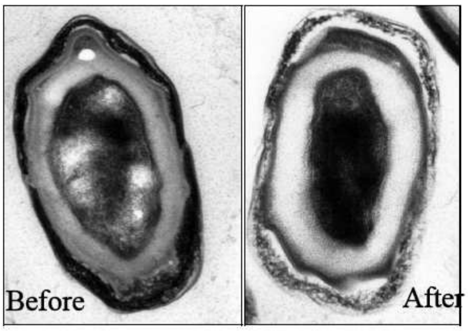
Ozone action on bacterial spores

Ozone at 5 ppm

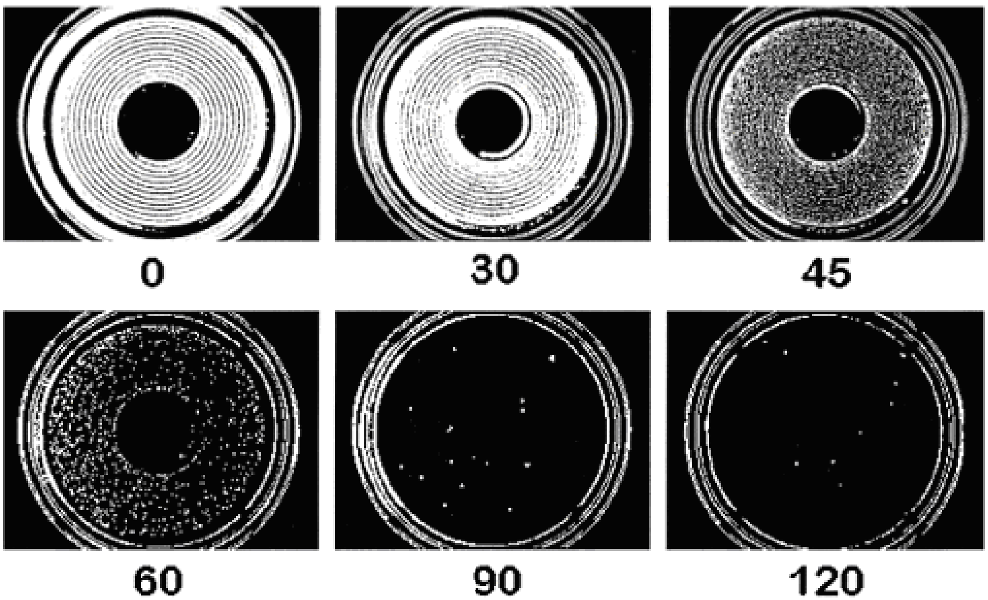
Damages spores coats (see the electron microscopic pictures).

Ozone at >5ppm

Total inactivation of spores



Khadre, M. A. and Yousef, A.E. 2001. Sporicidal action of ozone and hydrogen peroxide, a comparative study. Int. J. Food Microbiol. 71:131-138.



Spiral plated samples of *E. coli* with ozone exposure Images have been contrast enhanced to highlight the colonies. (Ozone concentration of 1-3ppm), Kowalski et al, 2003

Ozone kills diverse bacteria

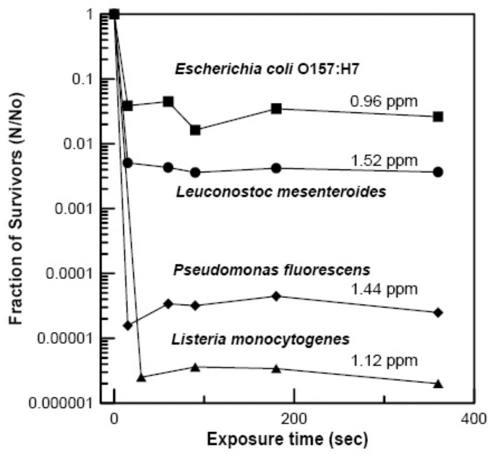
Spoilage and pathogenic bacteria are inactivated

Rapid inactivation

Ozone kills bacteria in less than 30s

Effective at low concentrations

~1ppm ozone kills up to 6 logs



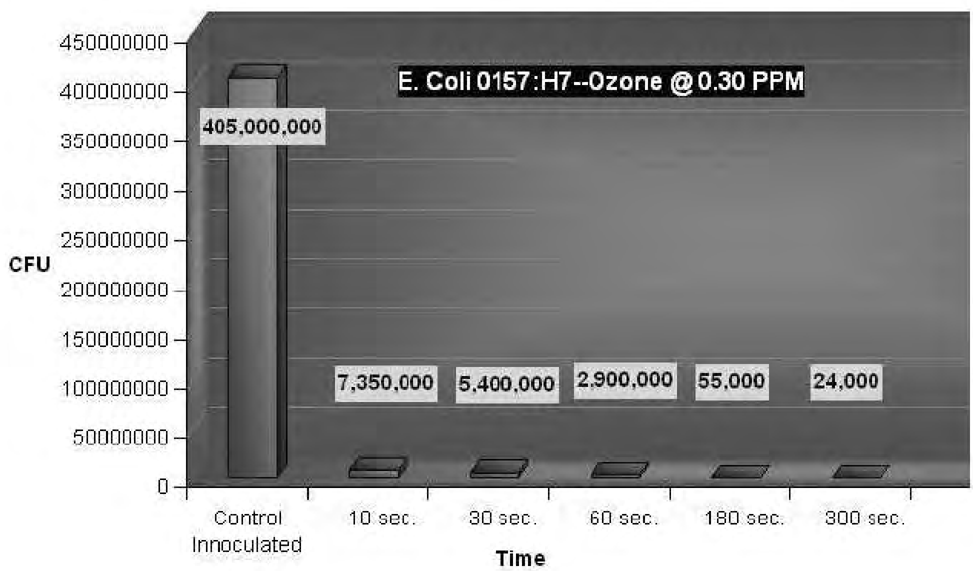
Inactivation of food-transmitted microorganisms (vegetative cell in pure suspensions) by aqueous ozone

(Kim & Yousef, 2000)

Decrease in spore count (log_{10}/ml) with exposure to ozone (0.22 mg ozone/20 ml mixture) or hydrogen peroxide (2000 mg H_2O_2/20 ml mixture) for 1 min at 22°C

(Khadre & Yousef, 2001)

Spore	O_3	H_2O_2
B. cereus OSU11	6.1	1.6
B. megaterium OSU125	2.1	0.93
B. polymyxa OSU443	1.9	0.58
B. stearothermophilus OSU24	1.3	0.64
B. subtilis OSU494	2.7	0.32
B. subtilis OSU848	4.8	1.2
B. subtilis ATCC 19659	6.1	0.64
B. subtilis vary Niger ATCC 9372	5.7	1.3



It is generally accepted that above a certain level, ozone will inactivate any organic contaminant. The following is a list of specific organisms shown to be inactivated by ozone.

BACTERIA

Achromobacter butyri NCI-9404
Aeromonas harveyi NC-2
Aeromonas salmonicida NC-1102
Bacillus anthracis
Bacillus cereus
B. coagulans
Bacillus globigii
Bacillus licheniformis
Bacillus megatherium sp.
Bacillus paratyphosus
B. prodigiosus
Bacillus subtilis
B. stearothermophilus
Clostridium botulinum
C. sporogenes
Clostridium tetoni
Cryptosporidium
Coliphage
Corynebacterium diphthriae
Eberthella typhosa
Endamoeba histolica
Escherichia coli
Escherichia coli
Flavorbacterium SP A-3
Leptospira canicola
Listeria
Micrococcus candidus
Micrococcus caseolyticus KM-15
Micrococcus spharaeroides
MRSA
Mycobacterium leprae
Mycobacterium tuberculosis
Neisseria catarrhalis
Phytomonas tumefaciens
Proteus vulgaris
Pseudomonas aeruginosa
Pseudomonas
fluorscens (bioflims)
Pseudomonas putida
Salmonella choleraesuis
Salmonella enteritidis
Salmonella typhimurium
Salmonella typhosa
Salmonella paratyphi
Sarcina lutea
Seratia marcescens
Shigella dysenteriae
Shigella flexnaria
Shigella paradysenteriae
Spirllum rubrum
Staphylococcus albus
Staphylococcus aureus
Streptococcus faecalis
Streptococcus hemolyticus
Streptococcus lactis
Streptococcus salivarius
Streptococcus viridans
Torula rubra
Vibrio alginolyticus & angwillarum
Vibrio clolarae
Vibrio comma
Virrio ichthyodermis NC-407
V. parahaemolyticus
Streptococcus 'C'

CYSTS

Cryptosporidium parvum
Giardia lamblia
Giardia muris

YEAST

Baker's yeast
Candida albicans-all forms
Common yeast cake
saccharomyces cerevisiae
saccharomyces ellipsoideus
saccharomyces sp.

VIRUS

Adenovirus (type 7a)
Bacteriophage (E.coli)
Calcivirus
Coxackie A9, B3, & B5
Cryptosporidium
Echovirus 1, 5, 12, &29
Encephalomyocarditis
Hepatitis A
HIV
GD V11 Virus
Onfectious hepatitis
Influenza
Legionella pneumophila
Polio virus (Poliomyelitus) 1, 2 & 3
Rotavirus
Tobacco mosaic
Vesicular Stomatitis

FUNGUS & MOLD SPORES

Aspergillus candidus
Aspergillus flavus (yellowish-green)
Aspergillus glaucus (bluish-green)
Aspergillus niger (black)
Aspergillus terreus, saitoi & oryzac
Botrytis allii
Colletotrichum lagenarium
Fusarium oxysporum
Grotrichum
Mucor recomosus A & B (white-gray)
Mucor piriformis
Oospora lactis (white)
Penicillium cyclopium
P. chrysogenum & citrinum
Penicillium digitatum (olive)
Penicillium glaucum
Penicillium expansum (olive)
Penicillium egyptiacum
Penicillium roqueforti (green)
Rhizopus nigricans (black)
Rhizopus stolonifer

PROTOZOA

Paramecium
Nematode eggs
Chlorella vulgaris (Algae)
All Pathogenic and Non-pathogenic
forms of Protozoa

ALGAE

Chlorella vulgaris
Thamnidium
Trichoderma viride
Verticillium albo-atrum
Verticillium dahliae
FUNGAL PATHONGENS
Alternaria solani
Botrytis cinerea
Fusarium oxysporum
Monilinia fruiticola
Monilinia laxa
Pythium ultimum
Phytophthora erythroseptica
Phytophthora parasitica
Rhizoctonia solani
Rhizopus stolonifera
Sclerotium rolfsii
Sclerotinia sclerotiorum