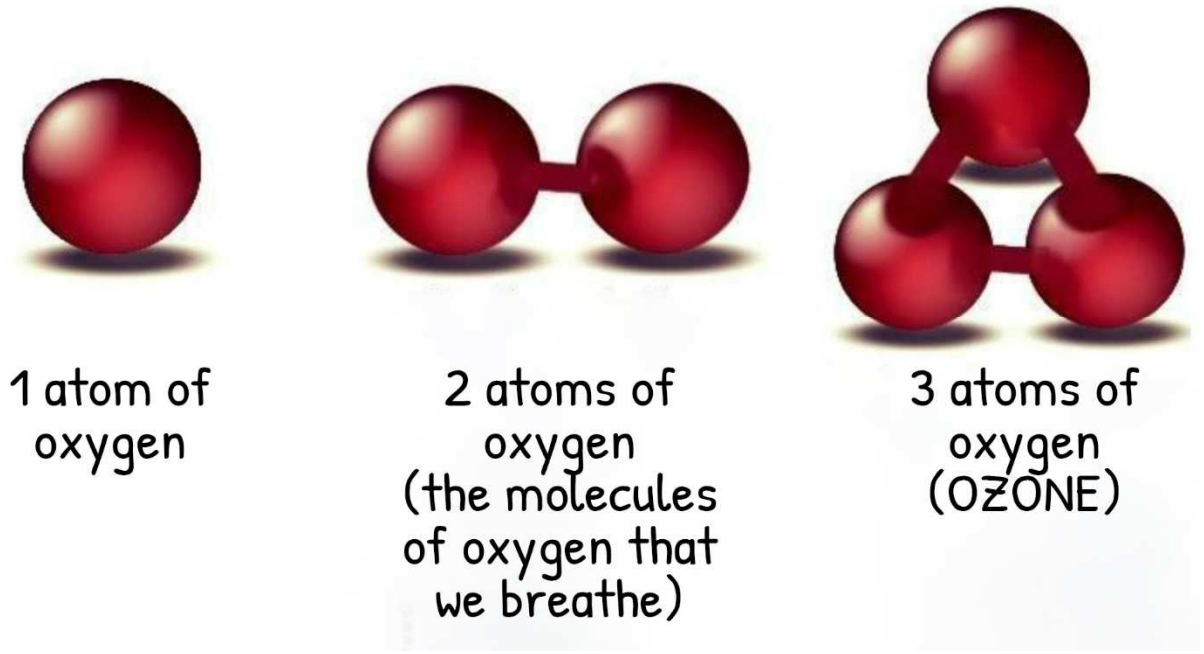
OZONATING LOCKER ROOM UNIT THAT HYGIENISES THROUGH OZONE

SUMMARY

1 WHAT EXACTLY IS THE OZONE?

The ozone molecule is simply an oxygen molecule (O_2) that is found in the air we breathe, enriched with an additional oxygen atom (which makes it an O_3).



The ozone is an unstable gas (reactive to other agents, so it dissolves in the air quite quickly). It cannot be stored and must be produced at the time of use.

It is colourless, and has a rather pungent smell, which you may have felt after a storm (the electric lightning discharge, in fact, can generate ozone).

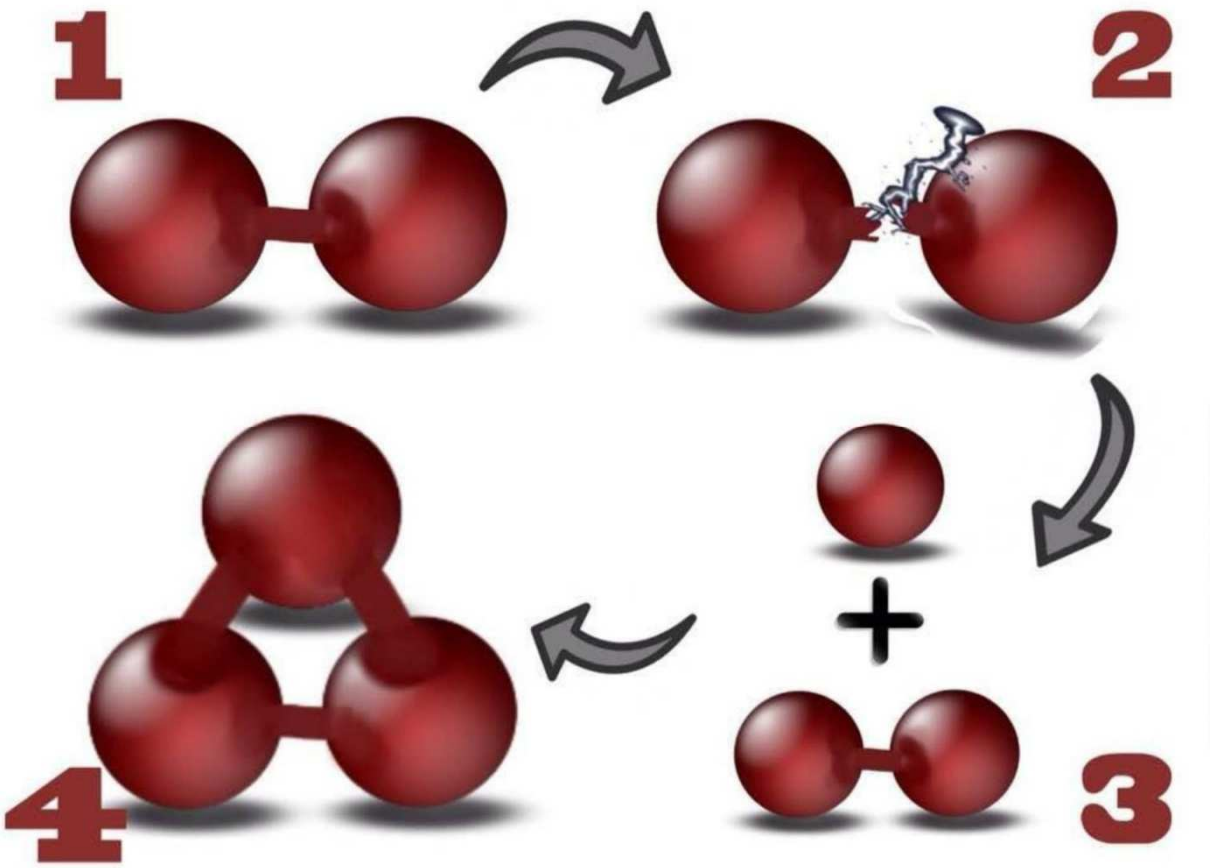
On a natural level, it is 20km above our heads, in the stratosphere, and plays an essential role in protecting us from UV rays.

Here, on the other hand, it can be produced by means of electric discharges.

2 HOW IS THE OZONE GENERATED?

Ozone is generated by the Crown Effect. Let's try to see it very briefly: on a plate of insulating material (in our case quartz, but beware that the cheapest models do not use this type of material) there are several electrodes, powered by high voltage.

Through a process, called photoelectric, many small discharges are created that, in extreme synthesis, will break the bond between the two atoms of a normal oxygen molecule in the air (O_2, composed of two oxygen atoms).The two atoms, now two free oxygen radicals, will attach to two other oxygen molecules in the air, forming two molecules of triatomic oxygen, O_3, that is, ozone.



Cartoon 1: a normal oxygen molecule in the air, consisting of two oxygen atoms.

Cartoon 2: the oxygen molecule is split into two free radicals through the corona effect.

Cartoon 3: the free radical is added to another oxygen molecule in the area.

Cartoon 4: here's a molecule of ozone from three oxygen atoms.

3 DOES THE OZONE SANITISE?

The oxidising action of ozone makes it the most effective bactericidal, fungicide and inactivating agent of the viruses; this oxidising action (higher than that of chlorine and peroxide water) sanitises air and environments.

It eliminates and destroys 99% of bacteria including the most "popular" bacteria such as *escherichia coli*, *salmonella enterica, listeria* and *staphylococcus aureus*, as well as many others that we do not mention for reasons of space! A concentration between 0.25 and 0.30ppm is capable of killing 99% of the bacteria present[1].

Viruses (including *SARS-CoV-1*, the next parent of the virus responsible for the *Covid-19*[2] pandemic) react to the sanitizing action of the ozone, but are more difficult to inactivate, but not beyond the generator's capabilities. A good amount of viruses (*Norovirus*, *Rotavirus, Vesicular Stomatitis Virus*, *influenza A virus* and others*) are* inactivated with concentrations up to 5ppm for one hour[3]. Other viruses may need higher concentrations for up to 3 hours[4].

The molds of the type *Aspergillus*[5]*,* as well as those of the families *Cladosporium* and *Stachybotrys*[6]*,* mushrooms like *Candida*[7] are very sensitive to ozone, although to be sure that a large majority of these are eliminated it is necessary to let it act for a period of around 3 hours.

The same action time is requested in the case of insects like the common dust mites, as well as the *Tyrophagus putrescientiae*, responsible for various allergies and skin reactions.

[1] Available summary: https://www.ncbi.nlm.nih.gov/pubmed/8267833

[2] http://www.triroc.com/sunnen/topics/sars.html

[3] Entire text available: https://www.researchgate.net/publication/13836535_A_new_ozone-based_method_for_virus_inactivation_Preliminary_study

[4] https://patents.google.com/patent/WO2005087278A1/en

[5] https://www.researchgate.net/publication/249034164_Inactivation_of_Aspergillus_spp_by_Ozone_Treatment

[6] https://www.ncbi.nlm.nih.gov/pubmed/18507305

[7] https://www.researchgate.net/publication/322662102_The_efficacy_of_gaseous_ozone_against_different_forms_of_Candida_albicans

4 WHY SANITISE WITH OZONE?

- Because it is natural: In 1996 the Ministry of Health designated it as “Natural Presidium for the sterilisation of environments contaminated with bacteria, viruses, spores, molds and mites[8]”. Its use is in compliance with Legislative Decree 193/2007 HACCP and the following Legislative Decree 81/2008. Its use as an active substance is also covered by ECHA, the European Chemical Substances Agency[9].

- Because it works in difficult places: being heavier than air, this creeps into those cracks and ravines that are difficult to reach during ordinary cleaning operations. Where the air enters, the ozone can enter too.

- Because it is clean: the ozone, at the concentration used in cleaning operations, leaves no residues or toxic by-products, it does not stain nor shrink[10].

- Because it deodorizes: in extreme synthesis, an ozone molecule in oxidation binds rapidly to each component with which it comes into contact; among these, even those so-called odorigenous particles, that is those that human smell perceives. By breaking down these into elementary particles, odors disappear or fade considerably. Do you ever leave a jacket on the terrace, which maybe smells like smoke or frying, to get it air? What happens is that odorigenic particles are oxidised by oxygen in the air. Ozone has one more molecule, it works much faster!

[8] See protocol nr.24482/ July 31st, 1996

[9] https://echa.europa.eu/substance-information/-/substanceinfo/100.030.051

[10] The ozone is used at an industrial level in order to decolour fabrics, but in massively higher doses than what is needed for our purpose

5 IS OZONE HARMFUL TO MAN?

The ozone can be harmful to humans if inhaled in large quantities or for a prolonged period of time, which, *however, are far greater than what may happen even by not performing perfectly what is recommended.*

It goes without saying that our advice is to perform the operations according to the manual, in order to eliminate any risk, even if minimal.

Guidelines have been issued, commonly accepted in Europe, by the American agency *OSHA* (for workers' safety) and the *FDA* (Food and Drug Administration).

* 0.06ppm for 8 hours a day, 5 days per week (ppm = Parts per Million)

* 0.30ppm for up to 15 minutes

These limits are the maximum acceptable concentration. It should be added that these concentrations are well above the odor threshold at which ozone can be detected by smell (0.008-0.02ppm).

Another American agency, *ACGIH*, the American Conference of Governmental Industrial Hygienists, has set a maximum limit of 0.20ppm, for a time that does not exceed two hours.

In a study published by the US National Research Council we also read that: *"Healthy patients were exposed to ozone up to 0.75ppm for 2 hours, while also performing mild exercise. A reduction in ventilative capacity (reduction of 25% in forced expiratory volume) has been reported. Chamber exposures have since shown that a critical concentration of ozone for a ventilative response is probably about 0.3-0.5ppm. (...) Most studies showed no effect at 0.25ppm*[11]*."*

Absorption of the substance through the skin (in the absence of deep wounds) is negligible. To date, ozone does not cause damage to the gastro-intestinal tract[12].

Therefore, ozone may be a disturbance to the respiratory tract, or cause irritation to the eyes and throat, but if inhaled in quantity.**In any case, this is not the case if all the safety measures that, in essence, consist of not staying in the environment while the disinfection takes place, to wait an hour for finished treatment and to air the room for about ten minutes more.**

Any disturbances related to the presence of ozone generally end if the affected are staying in healthy and aerated environments[13]. However, in case you are exposed to ozone for a prolonged time, we recommend that you consult your doctor even in the absence of symptoms.

[11] Summary in the following link: https://www.ncbi.nlm.nih.gov/books/NBK208281/

[12] Study made by IFA, the German Institute for the prevention of workplace injuries: http://gestis-en.itrust.de/nxt/gateway.dll/gestis_en/000000.xml?f=templates$fn=default.htm$vid=gestiseng:sdbeng$3.0

[13] https://www.emergency-live.com/it/wiki/intossicazione-da-ozono/

6 SANITISING CABINET WITH OZONE - THE PROFESSIONAL LINE

Sanitizing locker room unit PROFESSIONAL line: this type of cabinet does not affect the temperature, it simply cleans through ozone discharges.

The PROFESSIONAL version is equipped with an ozone generator and in addition to this it is equipped with a forced ventilation system (which helps to uniformise the ozone flow in the cell) and a digital system that, as we will see, allows different functions such as temperature control, ozonisation times, the event log, the ability to monitor or change the settings even remotely.

Images of the two versions of the cabinet WHITE and INOX SCOTCH-BRITE.

7 HOW DOES THE OZONE GENERATOR WORK IN THE HYGIENISING UNIT?

Ozone inputs, controlled through digital timers, are performed inside the cell, which is hermetically closed and does not allow any gas leakage outside.

In addition, for the sake of safety, the inlet fan shall be equipped with an FP-1 filter, i.e. filtering at least 80% of the particles of 0,6µm size (micrometers) present in the air.

At the end of the cleaning operations, in this version in which the ventilation is provided, it is used ten minutes before opening the closet to facilitate the decay of the ozone still in the air.

The safety device does not allow any ozone emission with the door open.

8 DOES THE OZONE RUIN TEXTILES?

No! The ozone, in the quantities released from the sanitising cabinet, does not wash out[14], does not felt wool or spoils silk[15].

Its use brings a great advantage on saving water and other types of detergents (which it does not replace, but implements and reduces the necessary quantities), as well as having an excellent deodorizing[16] power.

Carpets, pillowcases, sofa covers, mattress covers, duvets and anything else, can be ozonated without fear.

[14] The ozone can be used as a bleaching agent, but in much higher concentrations

[15] https://www.researchgate.net/publication/244752221_Ozone-Gas_Treatment_of_Wool_and_Silk_Fabrics

[16] https://www.intechopen.com/books/textile-industry-and-environment/use-of-ozone-in-the-textile-industry

9 DOES THE OZONISATION OPERATION IN THE CLOSETS POSE DANGER TO MAN?

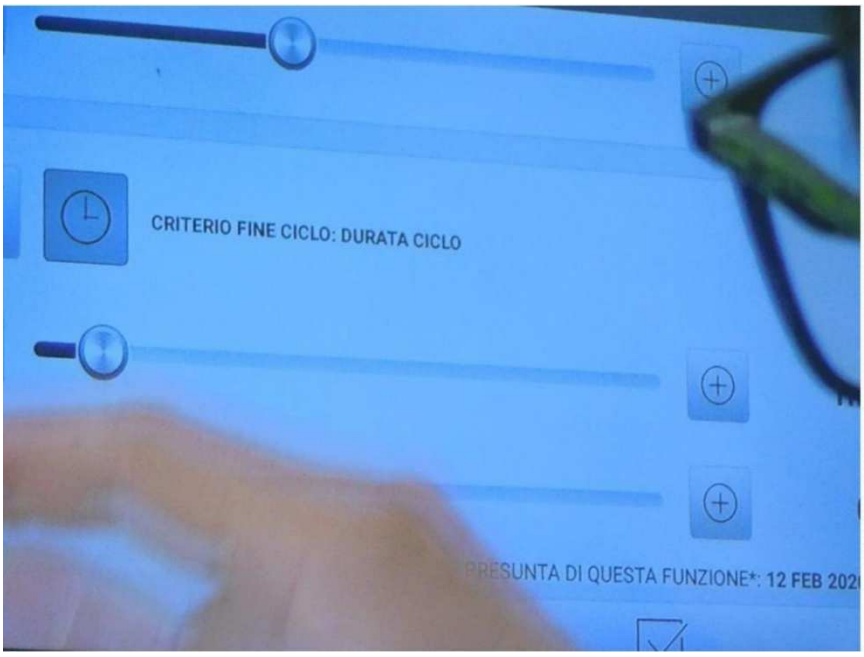
No, it does not pose dangers, either because the chamber is hermetically closed, and it is not possible for the ozone to get out of there (remember: ozone can only pass where the air passes), both because the quantities harmful to the operator are far from what is needed for the purposes for which the wardrobe is designed (see chapter “Is ozone harmful to man?”)

10 WHAT IS DIGITAL CONTROL FOR?

The environment cabinets of the PROFESSIONAL range are equipped with a digital control tab: this allows you to monitor the functioning of the machines you own, or which you perform assistance (in the case of dealers).In simple terms: remote control.

Virtually any modification to the software, as well as the modification of parameters and programs, can be done remotely, whether from the retailer’s warehouses, from the offices of the parent company or from the technician’s smart-phone.

To do this, of course, the machine needs to be connected to the internet (through Wi-Fi or 3G/4G), and the subscription (basic or advanced) to be activated. There is no need for special apps, nor programmes. Simply access the control screen through a common browser



11 RESISTANCE OF CERTAIN MATERIALS TO OZONE CORROSION

RESISTANCE OF CERTAIN TYPES OF MATERIALS TO OZONE IN A GASEOUS STATE

ASTRA® MOBILI METALLICI

MATERIAL	EXCELLENT RESISTANCE (NO TRACE OF OBVIOUS LONG-TERM ANGHE CORROSION)	GOOD RESISTANCE (MINIMUM VISUAL EFFECTS OF DISCOLORATION OR SLIGHT LONG-TERM CORROSION)	MODERATE RESISTANCE (THE MATERIAL MAY BE AFFECTED BY CONTACT WITH OZONE IF SUBJECTED DAILY)	LOW RESISTANCE (CONTACT WITH OZONE IS NOT RECOMMENDED)
ABS (Termoplasty)		X		
Stainless steels of an austenitic type (e.g.: AISI 304 and 316)	X			
Stainless steels of a non-austenitic type (e.g.: AISI 430)		X		
Non-stainless steel				X
Galvanised steel			X	
Silver	X			
Aluminium		X		
Bronze		X		
Natural rubber				X
CPVC	X			
Elastomer Hytrel			X	
Acrylic fibre		X		
Fluorosilicone	X			
Cast iron			X	
Butyl rubber	X			
EPDM rubber		X		
Ethylene-propylene rubber (EPM)	X			
Hypalon rubber			X	
Kalrez rubber (often used for gaskets)	X			
League Hastelloy	X			
Alloy Inconel	X			
Neoprene			X	
Nitrile				X
Nylon				X
Gold	X			

RESISTANCE OF CERTAIN TYPES OF MATERIALS TO OZONE IN A GASEOUS STATE

MATERIAL	EXCELLENT RESISTANCE (NO TRACE OF OBVIOUS LONG-TERM ANGHE CORROSION)	GOOD RESISTANCE (MINIMUM VISUAL EFFECTS OF DISCOLORATION OR SLIGHT LONG-TERM CORROSION)	MODERATE RESISTANCE (THE MATERIAL MAY BE AFFECTED BY CONTACT WITH OZONE IF SUBJECTED DAILY)	LOW RESISTANCE (CONTACT WITH OZONE IS NOT RECOMMENDED)
Brass		X		
Polyacrylate		X		
Polyamide			X	
Polycarbonate	X			
Polychlorotrifluoroethylene	X			
Polyethylene		X		
Low density polyethylene (LDPE)		X		
High density polyethylene	X			
Crosslinked polyethylene (Pe-X)	X			
Polypropylene			X	
Polysulfides		X		
Polyurethane	X			
PTFE (marketed as: Teflon, Fluon, Algoflon, Hostaflon, Inoflon)	X			
PVC		X		
PVDF (marketed as: Solef, Hylar, Kynar, Sygef)	X			
Copper		X		
Santoprene	X			
Silicone	X			
PEEK type technopolymer	X			
Titanium	X			
Glass	X			
Zinc				X

VALIDAZIONI SCIENTIFICHE DELL'OZONO

VALIDAZIONI SCIENTIFICHE DELL'USO DELL'OZONO

La FDA (Food & Drugs Administration), l'USDA (U.S. Department of Agricolture) e l'EPA (Environmental Protection Agency) hanno approvato l'Ozono come agente antimicrobico "GRAS", l'USDA ed il National Organic Program l'hanno approvato anche quale principio attivo per la sanitizzazione di superfici (plastiche e Inox) a contatto diretto con alimenti senza necessità di risciacquo e con nessun residuo chimico.

L'OZONO È STATO RICONOSCIUTO DAL MINISTERO DELLA SALUTE (PROTOCOLLO N. 24482 DEL 31 LUGLIO 1996) PRESIDIO NATURALE PER LA STERILIZZAZIONE DEGLI AMBIENTI CONTAMINATI DA BATTERI, VIRUS, SPORE ECC. E INFESTATI DA ACARI, INSETTI, ECC.

Dai dati ottenuti da una ricerca svolta presso l'Università degli Studi di Trieste - Dipartimento di Scienze della Vita (progetto D4 Rizoma anno 2007-2008) si evidenzia un abbattimento della carica microbica di oltre il 90% con concentrazioni non inferiori ai 2 ppm per almeno 6 ore di trattamento.
A concentrazioni più elevate si otteneva lo stesso risultato diminuendo il tempo di trattamento. Secondo studi effettuati dall'Università degli Studi di Pavia, Dip. di Scienze Fisiologiche Farmacologiche nel 2004, in una stanza di 115 m cubi trattata con ozonizzazione per 20 minuti la carica batterica dell'aria è stata ridotta del 63% e quella di lieviti e muffe del 46,5%, mentre la carica batterica delle superfici è stata ridotta del 90% e quella dei lieviti e muffe del 99%.

PROTOCOLLI RILASCIATI IN ITALIA:

- **Università di Napoli "Federico II"**
  prove in vitro del potere inattivante dell'ossigeno nascente verso enterobatteri patogeni e assenza di mutazioni genetiche

- **Università di Udine - Dipartimento di scienze degli alimenti prot. 219/94**
  test di decontaminazione su superfici piane di attrezzature adibite a lavorazioni carni salmonelle - listerie

- **Università degli Studi di Parma - Istituto di microbiologia**
  prove di verifica della capacità sterilizzante su colonie batteriche e .coli s.aureus - ps.aeruginosa - str duranS

- **Ministero della Sanità Istituto Superiore di Sanità -** Dipartimento Alimentazione e nutrizione veterinaria, protocolli depositati certificazioni, protocollo 24482 31/07/96

REPVBBLICA ITALIANA
Ministero della Salute