

# Respiro

RCI Radiant Catalytic Ionisation



**BREATHE** LIKE ON HIGH MOUNTAINS



A photograph of a person lying on a beige sofa in a bright, minimalist room. The person is wearing blue jeans and is lying on their side with their legs crossed. The background is a plain white wall, and the lighting is soft and even.

# —Respiro

**RESPIRO** is a device designed for air healthiness, environments and surrounding surfaces.

It is removable but it also comes with specific fastenings, so it can be hung on the wall, minimizing its overall dimensions and obtaining a minimal aesthetic impact.

Its tapered and linear shapes are well suited to all indoor styles.

# INFO



An adult  
breathes about 15 times/minute  
20.000 times/day  
average 10.000 liters of air in his system/body



Home environments  
5 times more polluted than external ones



Particles up to 3 micrometres enter the house even  
through hermetically sealed windows



Respirable particles reach the bronchial tubes and enter  
the bloodstream



75.000 people die prematurely every year because of the  
effects of air pollution. That is 20 times more than the victims  
of road accidents



In the last decades there has been an increase of allergic diseases



Over 90% of asthma cases in children is caused by allergen dust mite



Indoor pollution is responsible for 4,6% of death in children from 0 to 4 years



Indoor pollution is responsible for 2,7% of world diseases



20-30% of households has problems of moisture resulting in a 50% increase in risk of respiratory disorder and in a 13% increase of childhood asthma cases (OMS 2009).

# PHOTOCATALYSIS

**RESPIRO** is equipped with a powerful tangential fan able to ensure an air recirculation of about 400 m<sup>3</sup>/h. It uses a **RCI** (Radiant Catalytic Ionisation) technology, that is photocatalytic oxidation.

The photocatalytic process reproduces what happens in nature, namely a photochemical reaction that allows to destroy pollutants, in particular bacteria, viruses, mold, allergens and smells with a natural active ingredient

Photocatalysis is a process that, thanks to the combined action of sun's **UV rays**, humidity and other naturally occurring noble metals, generates **oxidizing ions** able to destroy most of polluting and toxic substances

To such action combined with other factors is further added the disinfecting action of **Ozone**

## OPERATING PRINCIPLES

**RESPIRO's** tangential technology of Oxidation is enclosed in a control room where an **UV** lamp is, that generates **UVC** rays.

The control room is covered with Titanium dioxide (TiO<sub>2</sub>), able to react with ultraviolet radiation, by activating photocatalysis process.

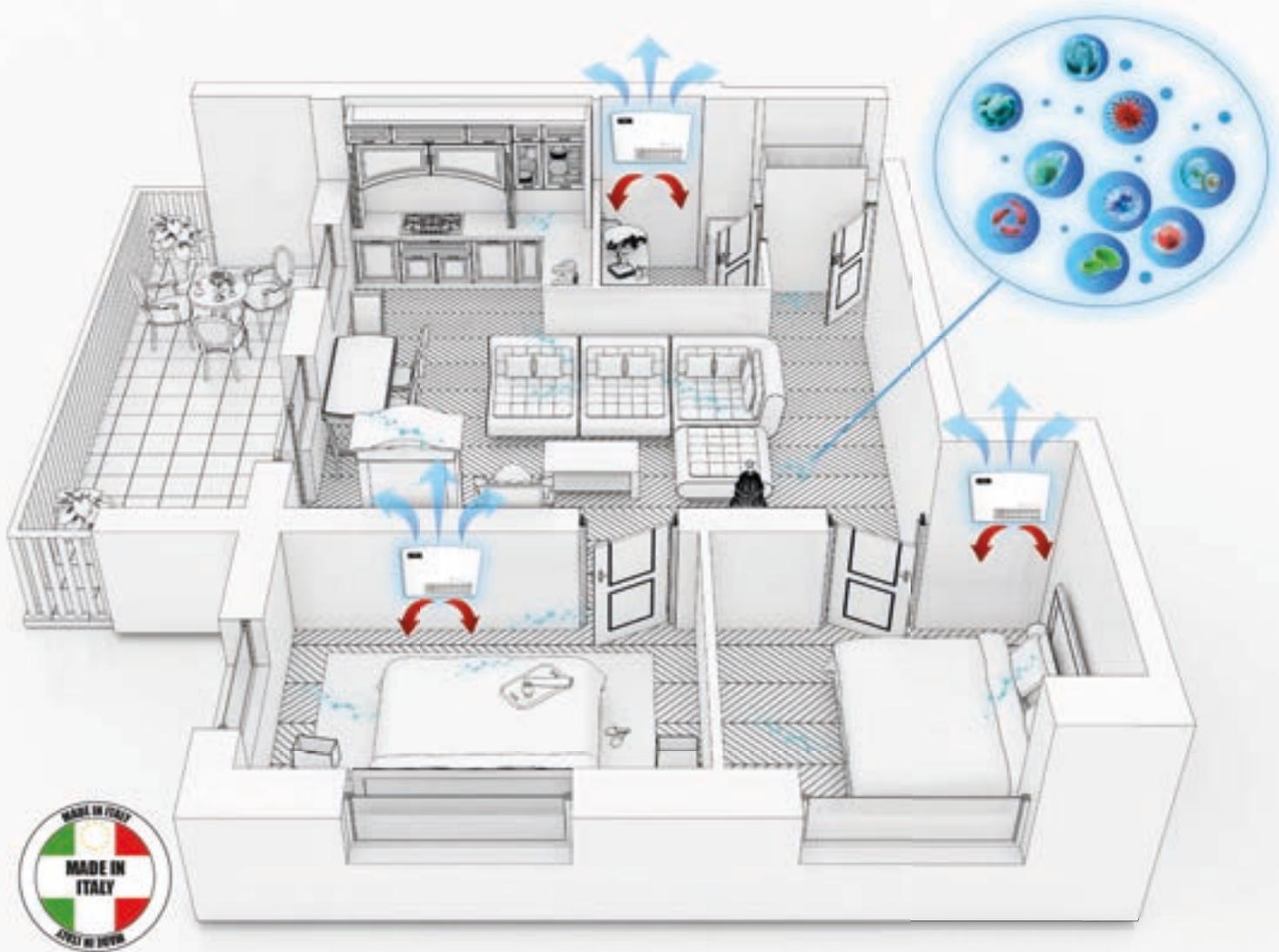
Agenzia europea dell'ambiente



**DEFINES POLLUTION AS THE ALTERATION, DIRECTLY OR INDIRECTLY CAUSED BY HUMANS, OF ENVIRONMENT'S BIOLOGICAL, PHYSICAL, CHEMICAL PROPERTIES, WHEN THERE IS A RISK FOR HUMAN HEALTH OR FOR EVERY LIVING SPECIES SAFETY AND WELLNESS.**



# INDOOR BUILT - IN SANITIZATION



## H24 ACTIVE HEALTHINESS EVEN IN THE PRESENCE OF PEOPLE

- UVC Ultraviolet light irradiation (100-280nm)
- Oxidizing Ions generated to 200ML/cm<sup>3</sup>
- Ionizing Service-Life 30000/h
- Relative humidity in the environment of at least 40%

# PHOTOCATALYSIS OPERATING PROCESS

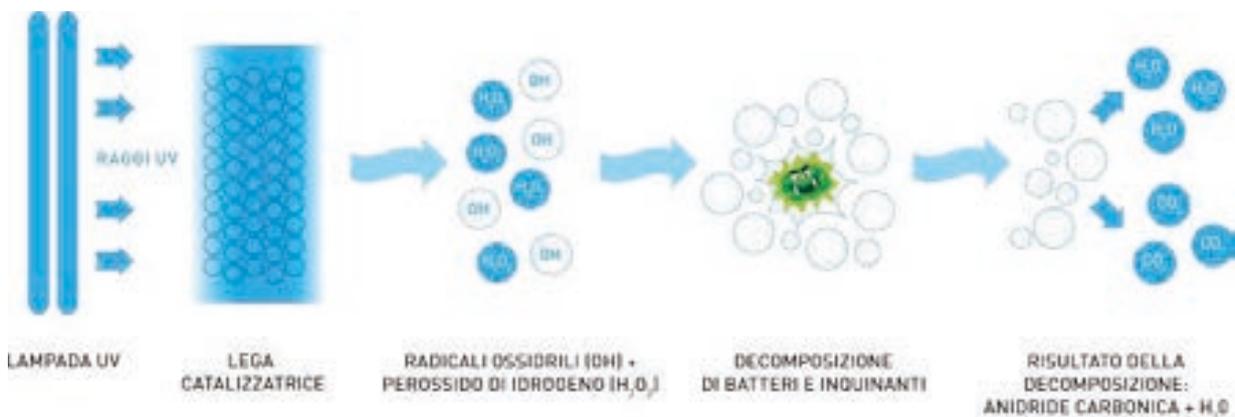
The **airflow** conveyed by the tangential fan enter inside the chamber coated with titanium dioxide and radiated by the UV lamp.

The ultraviolet radiation floods a catalytic structure made of a metal alloy with honeycomb matrix, mainly composed of Titanium Dioxide and other noble metals. The air inside generates a photochemical reaction of oxidation; **hydrogen peroxide** ( $H_2O_2$ ) in gas form and two highly reactive molecules (**hydroxyl radicals**  $OH$  and **idroperoxyl radicals**  $HO_2$ ) are thus produced.

The moisture-laden airflow, conveyed by the ventilation system, passes through the module composed of metal alloy.

A photochemical reaction of oxidation starts thanks to the action of the high-intensity UV lamp (254nm  $h\nu$  UVX), producing hydroxyl radicals, **OH**, and hydrogen peroxide,  $H_2O_2$ .

There will be a decomposition of bacteria and pollutants through the oxidation reaction and a virus inactivation, increasing Oxygen level.



The release of such air in the environment starts, at the same time, bacteria and pollutants decomposition and **virus inactivation**.

In this way you get a safe, effective and complete air sanitation.

Besides, the disinfected air, by gravity, allows the sanitation of treated premises surfaces and any present fabrics (clothing and furnishings).

At the end of sanitation, radicals and hydrogen peroxide turn into **Carbon Dioxide** ( $CO_2$ ) and **Water Vapor** ( $H_2O$ ).

**SPREADING IN THE ENVIRONMENT AND BY DEPOSITING ON AIR DUCTS AND PREMISES SURFACES, HYDROGEN PEROXIDE ALLOWS A SAFE, EFFECTIVE AND COMPLETE SANITATION.**

# IONIZATION

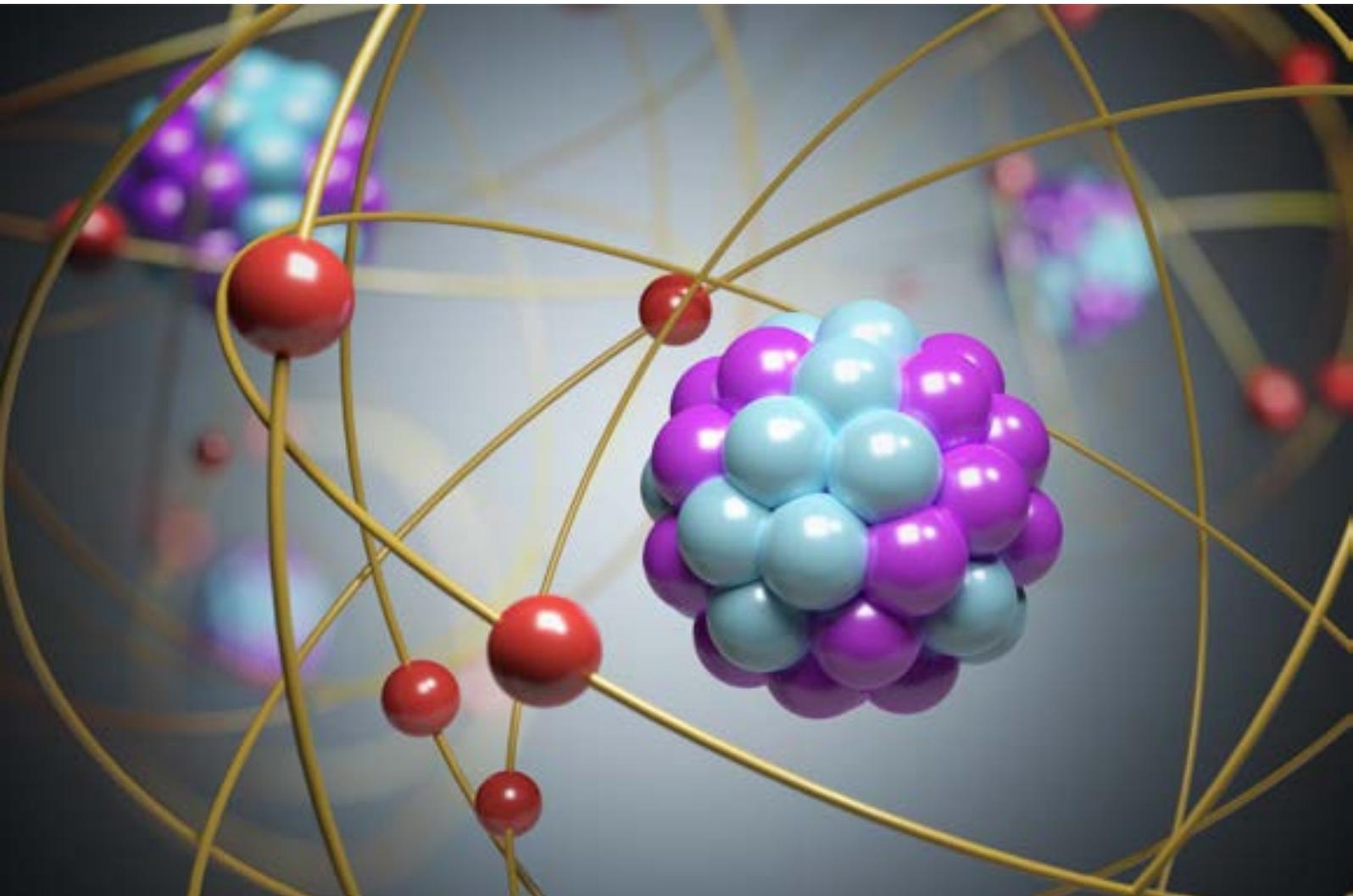
The operating principle of an **air ionizer is based on charging the gas atoms with a high current.**

Negative ions emitted by the device prevent the dispersion of particles contained in the air that get electrostatically charged

**Ions that lose an electron are negative and they are also called anions.**

The corona effect discharge, basic principle of ionisation, happens in the presence of high intensity electric fields generated by natural phenomena, like storms or lightnings.

The discharge given by corona effect is an effective way to generate negative ions by applying a negative high voltage to a conductor.



**A ION IS FORMED WHEN A MOLECULE OR AN ATOM RECEIVES A SUFFICIENTLY HIGH ENERGY TO GIVE UP AN ELECTRON**

# EFFECTS OF IONIZATION

## NEGATIVE IONS – POSITIVE INFLUENCE ON HUMAN HEALTH, STRESS AND COGNITION

A study promoted by Associazione Centro Tutela Cittadino has developed a scientific paper for that it concerns the effects of air ionization on depression, anxiety and mental well-being and has reported the effects of positive and negative ions, using RESPIRO as a base for the activities and by measuring time and impact in its presence or absence.

In fact, the study has been conducted relying on existing Scientific Literature and testing RESPIRO within a limited number of private places (houses, offices) located in different Italian cities with specific characteristics representative of the phenomenon that they were studying.

During the monitoring period, several beneficial effects of air ionization on anxiety, mood, relaxation, sleep and personal comfort have been found.

Women who have received a negative ions treatment have shown the reduction of symptoms of depression, anxiety, asthma and a reduced use of corticosteroid, prednisolone and antibiotic.



STUDY INITIATION AND CLINIC VALUATION OF MONITORING OF N.200  
SUBJECTS  
EXPOSED, AND NOT, TO IONIZING TECHNOLOGY FOR VALIDATION  
PURPOSE OF  
BENEFICIAL EFFECTS ON QUALITY AND HEALTHINESS OF THE DOMESTIC  
ENVIRONMENT AND ON HUMAN PSYCHO-PHYSICAL WELL-BEING.

Year 2018/2019



# RESEARCH INITIATION

Nevertheless, the study has analyzed the effects of ionization on surfaces and how this kind of disinfection has a significant action on the test subjects welfare.

The research has, indeed, demonstrated that filling the air with negative ions (which help the individual to breathe better and improve the absorption of Oxygen) to the detriment of the positive ones (which make breathing more difficult) is fundamental.

## IONS – BACTERIA INTERACTION

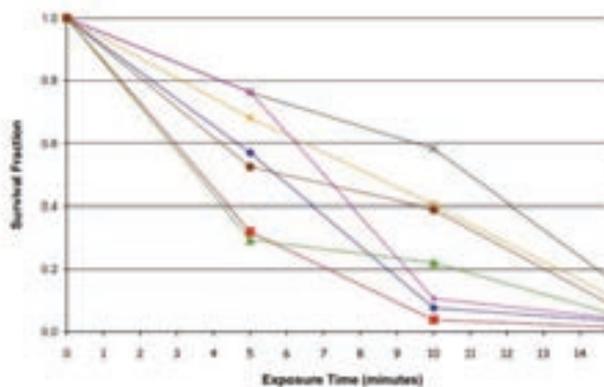
It occurred, in particular, what scientific literature affirmed, observing how a daily ionization has affected even a greater reduction of bacteria on washable surfaces like plastic, laminated and glass.

By linking this improvement with the test subject's psycho-physical condition, by checking the removal of depressive disorders, humoral alterations, feelings of fatigue and confusion.

It has been noted a slow and gradual increase in the level of satisfaction and a better response to external stimuli.

The whole thing has been linked with the healthier environment, that has affected the sensory response of the test subject.

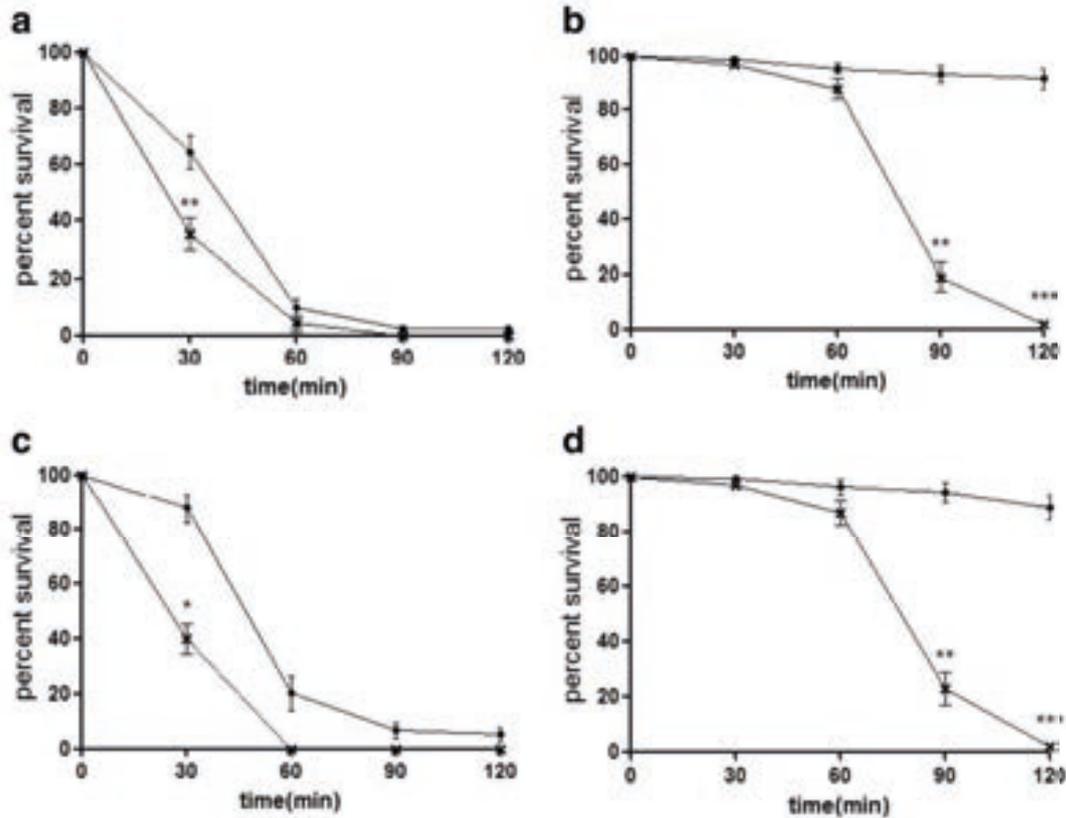
For each type of bacterial species, there has been a remarkable decrease in the number of colonies.



### BACTERIAL STRAINS ANALYSED

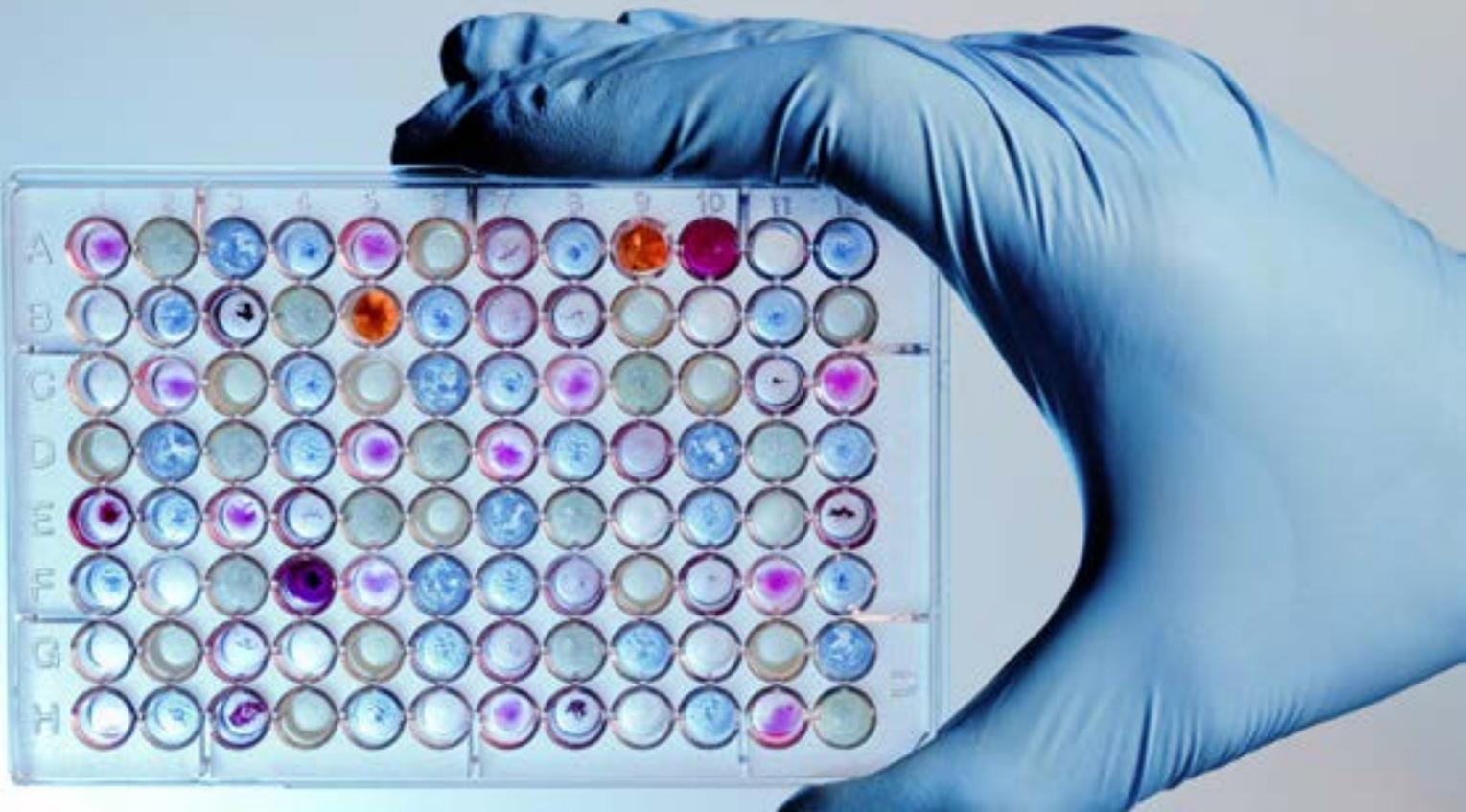
*S. Marcescens*  
*P. Aeruginosa*  
*A. Baumannii*  
*M. Parafortuitum*  
*S. Aureus*  
*B. Subtilis*  
*B. Cenocepacacia*

Tests conducted by scientific studies and collected in situ with steril swabs, with a room temperature characterized by an average relative humidity of 60-70%. Data collected in casual test subject and control test subject (in absence of ionization)



Note: Grafico estratto da Letteratura scientifica: Ion Oxidation efficiency - Journal of Photochemistry and Photobiology - Volume 216 Issues 2-3, Dec 2010

From the graphic representation it follows that the effect of ionization (only while it is present) has recorded an exponential decay in connection with temporal exposures from 30' to 60' until it gets to 120', in which the lowest threshold of detection of bacterial strains presence has been recorded. The control test subject, on the right of the graph, verifies how this bacterial presence remains at the same temporal exposure of 120'.



# IONS – VIRUSES INTERACTIONS

To date, simple and validated technologies able to collect viruses from the air don't exist.

In the study in literature, effects of ionization have been seen on different types of viruses of clinical relevance like **calicivirus**, **rotavirus** and **influenza virus**

**The main result of the study has indicated that air ionization leads to the loss of virus infectivity.**

The authors of the scientific study examined have followed and drawn up a specific matrix of detection on data derived from flu-like and comparable symptoms on test subjects (casual and controlled), by verifying their different immunological response in treated and not treated sites with air ionization.

Results have shown that in the “casual” test group with the ionizer enabled they prevented 4 out of 4 exposed swines to develop influenza viruses; in the second test group “control”, with the ionizer inactive , 3 out of 4 swines were infected. Based on this, they proceeded to allocate RESPIRO within the sites identified for monitoring, verifying the correlative impact with other endogenous factors, such as the spread of airborne viral infections or the ease of transmission of contagion within the same place.

The Centro Tutela Cittadino has assumed that the exposure to negative ions induces numerous beneficial effects on animal and human health, against microorganisms.



## IONS – DUST MITES INTERACTION

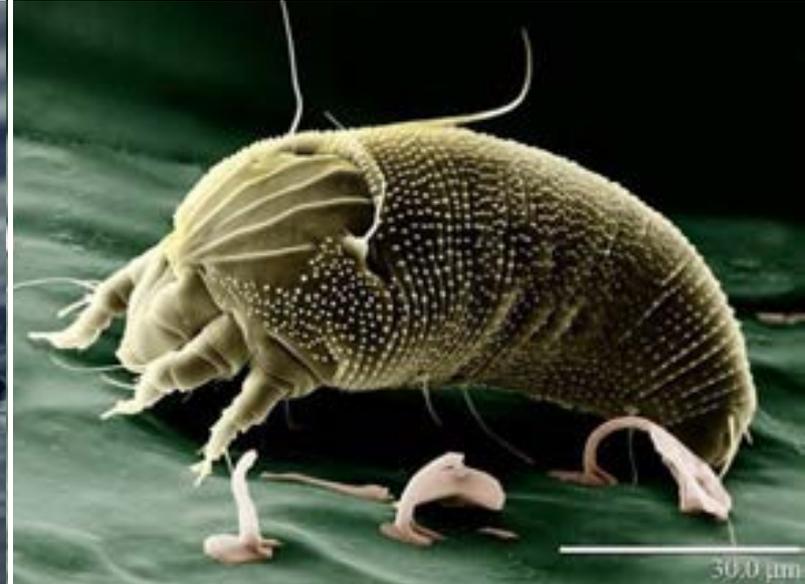
The study examined has even shown an increased mortality of dust mites thanks to negative ions.

Mites are the main allergen source in wetlands and they represent a potential risk of rhinitis, asthma, atopic dermatitis and lung disease.

There are two types of mites: *Dermatophagoides pteronyssinus* and *Dermatophagoides farinae*.



*Dermatophagoides pteronyssinus*



*Dermatophagoides farinae*

It takes **35** days for the mite, under favourable conditions, to go from egg to adult.

The female lives about **70** days and **it approximately lays an egg every day for a period of 30 days. A single mite produces from 20 to 40 pieces of excrements per day.**

**It feeds of organic debris**, such as skin flakes, which are easily found in places frequented by people. Mites dust particles are smaller than 5 micrometres, thus they may go deep into the respiratory system, nesting deeply in the lungs.

Results of the study have shown an increased mortality of dust mites on exposed surfaces (like floors, clothes, curtains etc.) with an increasing exposure time.

CTC has correlated the presence of RESPIRO with the weakening of allergic asthmatic phenomena caused by mites, by verifying a positive response of the sample tested.

# IONS – SURFACES INTERACTION

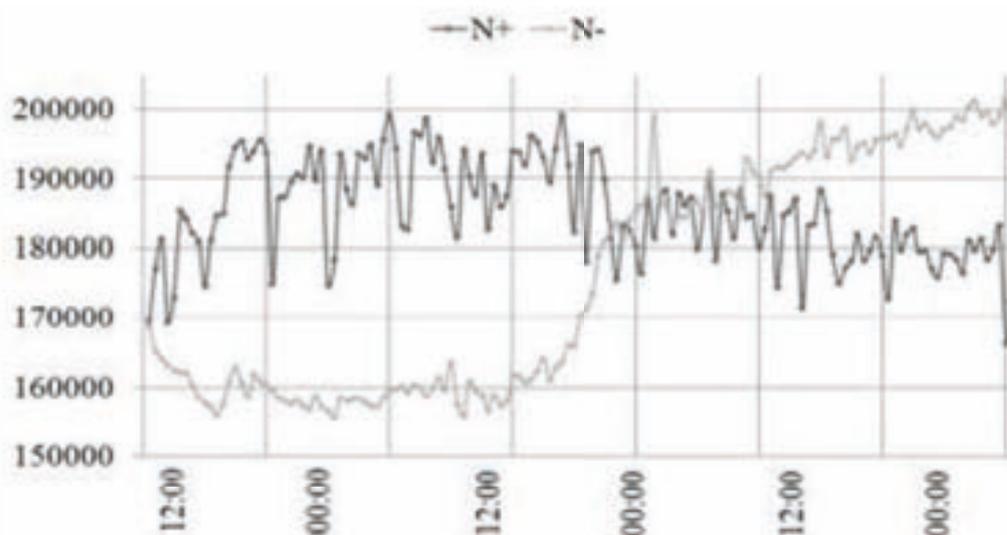
The scientific study examined measured a significant reduction of Acinetobacter infection in the presence of negative air ionizers. Acinetobacter is a microorganism responsible for respiratory tract infection associated with the contamination of fans and other respiratory therapy devices.

Negative ions charge surfaces so as to reject, instead of attracting, airborne bacteria. The ions counter of the study measured less than 1000 ions/cm<sup>3</sup> when the ionizer had been turned off and 28800-85600 ions/cm<sup>3</sup> when the device was on.

The monitoring of Centro Tutela Cittadino veri ed the electrostatic force repulsion generated by RESPIRO using particles, noticing how they were rejected by surfaces avoiding contamination.

Results collected by CTC showed that ions in the air can modify the surface potential of the material with benefits against the contamination of air particles, depending on triboelectric properties on the material itself, by verifying the absence of pulviscular particulate on surfaces examined.

The triboelectric property of the materials is their capacity to self-charge positively or negatively.



Note: Grafico estratto da Letteratura scientifica: Ion Oxidation efficiency - Journal of Photochemistry and Photobiology - Volume 216 Issues 2-3, Dec 2010

As shown, the maximum number of ions has been detected during the night; on the contrary, the concentration has decreased during the day. Authors explained this result as follows: negatively charged surfaces are characterized by electrons that flow through the dielectric surface.

When an electron is released, the surface becomes positively charged and it leads to a change in the air ions concentration.

## **IONS – SURFACES INTERACTION**

The study measured a significant reduction of Acinetobacter infection in the presence of the radiant photocatalytic ionization device RESPIRO, responsible for generating negative ions in the air.

Negative ions in RESPIRO charge surfaces so as to reject, instead of attracting, airborne bacteria.

The ion counter measured about 200.000.000 ions/cm<sup>3</sup> when the device was on. Therefore, the electrostatic repulsion force ensures that the particles are rejected from the surface avoiding the contamination.

Therefore, the results of the scientific study, under which air ions modify the surface potential of the material with benefits against the contaminations of air particles depending on triboelectric properties on the material itself, are confirmed.



# IONS – PARTICULATE MATTER INTERACTIONS

**PM is the main pollutant that seriously affects human health.**

It penetrates the lung and it damages the alveolar walls and, consequently, respiratory functions.

The World Health Organization (WHO) quantified the effects of the exposure to **PM10** and **PM2.5** in the form of air pollution and it has determined the symptoms: **acute symptoms (wheezing, cough, production of phlegm, respiratory infection), eye, nose and mouth irritation, headache, dizziness, skin rashes, muscle pain, fatigue and chronic alterations in physiological functions.**

Taking roads not so busy doesn't solve the problem, because, very often, the fine particle level outdoor is lower than indoor one (at home, at school, in offices).

Fine dust are especially man-made, such as vehicle exhaust gases, combustion or open fires, industrial plants, results of agricultural transformations, heating or domestic ventilation systems..., but they also have natural origins, that is from plants, forest fires, microorganisms, volcanic eruption and rocks erosion.

Tests carried out by the air detection of the scientific study formed the correlation matrix with the presence of the ionizing process and the verification of PM presence and concentration.

CTC has verified how RESPIRO produces a negative electric charge able to reduce fog, smoke and atmosphere particulate matter; the experiment has been conducted under a glass case with activated measuring device.



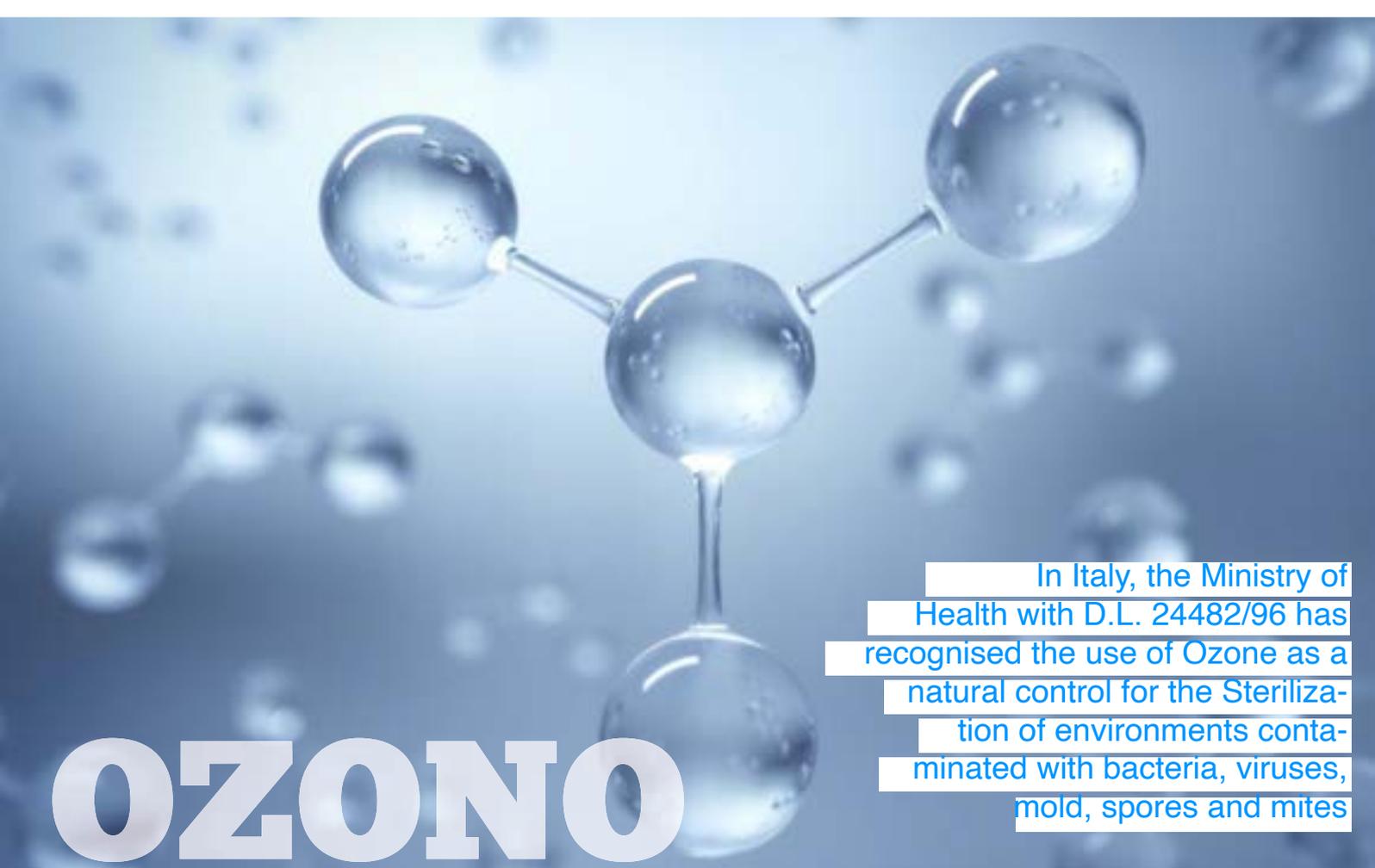
# OZONE

The main features of the Ozone are:

- It has a high oxidizing power, since it is a highly unstable molecule;
- It is able to degrade complex non biodegradable organic compounds;
- It has a powerful broad-spectrum disinfectant action;
- It can be used for water, air and environments sanitization;
- Contrary to other disinfectants (like Chlorine), it does not leave residue;
- After 20 minutes, O<sub>3</sub> turns into Oxygen and it does not require elimination treatments.

Ozone generated in situ converting Oxygen through electric discharges is an active substance “**biocide-action**”, disinfectant for surfaces and drinking water. Although the evaluation has not been completed, it is available a large amount of data, confirming the **microbicidal effectiveness even on viruses** (Report ISS COVID-19 n.25/2020 of Working Group ISS Biocides COVID-19).

Ozone is widely used in the food sector since it significantly limits air, water and surfaces contamination. For example, it plays a key role in cheese aging and in the **rinse water treatment** in the Food processing industry.



# OZONO

In Italy, the Ministry of Health with D.L. 24482/96 has recognised the use of Ozone as a natural control for the Sterilization of environments contaminated with bacteria, viruses, mold, spores and mites

# BIOCIDE ACTIVITY

The Ozone (O<sub>3</sub>) is an unstable gas that includes three atoms of Oxygen. It is unstable because it degrades rapidly to its stable state, diatomic Oxygen (O<sub>2</sub>), with the formation of free oxygen atoms or free radicals.

Free Oxygen atoms or radicals are highly reactive and they oxidize almost everything (including viruses, bacteria, organic and inorganic compounds), making Ozone an extremely powerful disinfectant and oxidant.

In fact, Ozone is an oxidant a lot stronger than other disinfectants like Chlorine and Hypochlorite. The use of Chlorine or Hypochlorite has been significantly reduced in many countries because of the chance to form carcinogenic by-products, like trihalomethanes (THM), during the disinfection process.

On the contrary, the disinfection with Ozone does not produce harmful residues, therefore residual Ozone will be later converted back to Oxygen.

The Ozone is thus considered an ecological disinfectant.

Due to its strength and efficacy as oxidant and biocide, the Ozone becomes one of the air treatment technologies, especially by virtue of the last historical events of 2020.

The Ozone, in addition to its sanitising power, can greatly help to remove any kind of smell (kitchen or cigarette), being useful especially in restricted environments, such as one-room apartments.



## **FILTER MEDIA – SILVER-PLATED CARBON**

A further stage of filtration and exclusion of unwanted particles from the air is the Activated Silverplated Carbon Filter System, able to reduce air pollutants concentrations.

This stage plays an important role in microfiltration with an antibacterial and bacteriostatic action, since it is silver-impregnated.

Filter Media has incorporated silver particles by the powerful antimicrobial action, with a filtration efficiency above 98,5% regarding particles with a diameter of 2,5 micron, such as pollen and dust; at the same time, it assures the elimination of harmful gases, like nitrogen oxides, and bad smell.

The new polymeric synthetic fibre exponentially increases the antibacterial properties of the filter not only by neutralizing bacteria, fungi and mold, but also guaranteeing a longer life of its properties

In fact, precisely because the antibacterial layer is integrated within the fibres and not overlaid with others, it maintains the antibacterial function over the whole lifecycle, without being scattered by using.

It manages to reduce by over 99% the bacterial load in the air, as well as to improve its quality thanks to the action of activated carbon.





# ACTIVE SANITIZATION





**PATENTED  
TECHNOLOGY**



**INDUSTRIAL PATENTS  
DEPOSIT**

*Multifunction Device for Air Treatment  
in Healthcare and Civil Environments  
with RCI Technology  
(Radiant Catalytic Ionisation)*



102020000018475

Director

# UNIQUE TECHNOLOGY - PATENT RCI/ HEPA, SYSTEMS IN COMPARISON

A comparative analysis of RESPIRO's main features, confronted with the traditional microfiltration technology with the use of HEPA system.

## RCI

Active Sanitization

The sanitization is a process that eliminates large amounts of material which are not part of an element, including dust, a large number of microorganisms and the organic matter that protects them. Sanitiation means carrying out, in two different moments, the removal of the cause of contamination and the disinfection of any surface and of the surrounding air.

That is to say an integrated system of synergistic and complementary multiple technologies which carries out a dynamical sanitization that returns a fresh air.

## FUNCTIONING

The air free of contaminants goes through an integrated system of different and synergistically complementary processes that lead to an air rarefaction and disinfection noticeable even during the simple release in the indoor environment.

## HEPA

Passive purification

The purification describes a process that distances pathogenic microorganisms that are present in a specific environment or substrate. This does not mean, therefore, the destruction or the removal of bacterial or microbial strains, but only the reduction for the sequential crossing through different filtration phases.

## FUNCTIONING

The air goes through the HEPA filter that traps contaminated particles without destroying them, keeping them in the filter until the cleaning. This process, in order to assure a satisfactory performance, needs a regular maintenance and the replacement of the filter cartridge.

# ICR/ HEPA, SYSTEMS IN COMPARISON

## ACTION

It acts on nanoparticles over 0,001 micron

The volume of the treated environment depends on the airflow rate; it is equipped with a powerful tangential fan able to ensure a recirculation of about 400 m<sup>3</sup>/h.

It sanitises even surfaces, fabrics and all the objects in the indoor environment.

Thanks to the final phase of the treatment, it is able to act on smells, volatile organic compounds (VOC) and gases like ethylene, slowing down the maturation of fruits and vegetables.

It fights bacterial proliferation following the sanitization.

Prevents the formation of moulds and spores.

It does not allow the next proliferation of pathogens, working h24 even in the presence of people.

## MAINTENANCE

Lamp UV replacement every 9.000 hours (just over a year of use h24)

## ACTION

It filters only particles over 0,3 micron

The volume of the treated environment depends on the suction capacity from the back of the device.

It does not act on surfaces, since only the air that goes through the filter can be sanitized.

No action on smells, volatile organic compounds (VOC) and gases.

## MAINTENANCE

Periodic replacement of the filter, based on the accumulated dirt. The filter reduces the exhaust air rate, especially if it is dirty.





*Respiro*





## POLLING SAMPLE SURVEY

**Nowadays we spend up to 90% of our time indoors, 30-40% of it in workplace**

The air that we breathe in indoor environments is treated and distributed by distribution systems that often become factors in air contamination.

Centro Tutela Cittadino has conducted a sampling pilot survey on the national territory, verifying the healthiness of environments.

25

**SOGGETTI SOTTOPOSTI  
A CAMPIONE**

**NORTH**



**SOUTH**

## POTENTIAL TARGET

The sampling started in November 2019; the acceptance of the participation has made the benchmarked sample representative of the statistical universe that they wanted to analyse, taking as sample cases private environments located in different Italian cities with a different allocation from the city centre.

The entire sample analysed has been used at least for 8-9 consecutive hours per day.



In the last few years institutions are giving more and more value to actions directed to prevent life environments, that is improving the quality and the health of living spaces. The existence of healthy environments, beneficial to the well-being of the citizen, is an essential element in primary prevention. In order to ensure healthy and safe living environments, especially those frequented by children, the Minister of Health has promoted and developed important initiatives in order to protect and promote the health in environments with births. In April 1998 it has been established the indoor Commission, of a multidisciplinary character, composed of engineers, architects, occupational doctors, hygienists, allergists, bronchopulmonologists, epidemiologists, ISS and ISPESL experts, to work out the National Plan for the protection and the promotion of health in environments with births (2000), with the favourable opinion of the Superior Council of Health. On the basis of the Plan's instructions, direction Lines for the protection and the promotion of health in environments with births have been developed, approved with the Agreement of 27 September 2001.

Subsequently, "GUIDANCE FOR A HEALTHY LIVING ENVIRONMENT" has been designed and promoted by Associazione C.T.C. Centro Tutela Cittadino, to protect the environment and the public health. The guidance is meant to be an informative and popular tool to raise awareness and educate the citizen, the administrations and all professionals involved on the field of security in life and work environment, that is to say on issues related to the indoor air quality and on systems that help to reduce the level of indoor pollutants.

This handbook represents a concrete contribution aimed at raising awareness of Citizens on issues related to the Environment and its eco-sustainable development, the safety of the living environment, the new eco-sustainable technologies and the new devices to assist the citizen. The handbook wants to offer, in particular to consumers, a guidance and some useful informations that can lead them to improve the quality of their lives.

Milano 13/11/2019



# REMOTE ANALYTIC TELEMETRY



An air cleaning system with a meter of continuous control of environmental health has been installed to the sample, that randomly and daily records a string data equivalent to a specific serial number associated with each device connected to a primary unit of the sample.

The temporal analysis lasted 6 months, during which it was possible to analyse a particular hystorical period of Covid-19, that has accentuated the significance of the statistical treatment, having analysed a period of intense domestic activity due to the forced segregation imposed by the first DPCM, dated 23 February 2020.

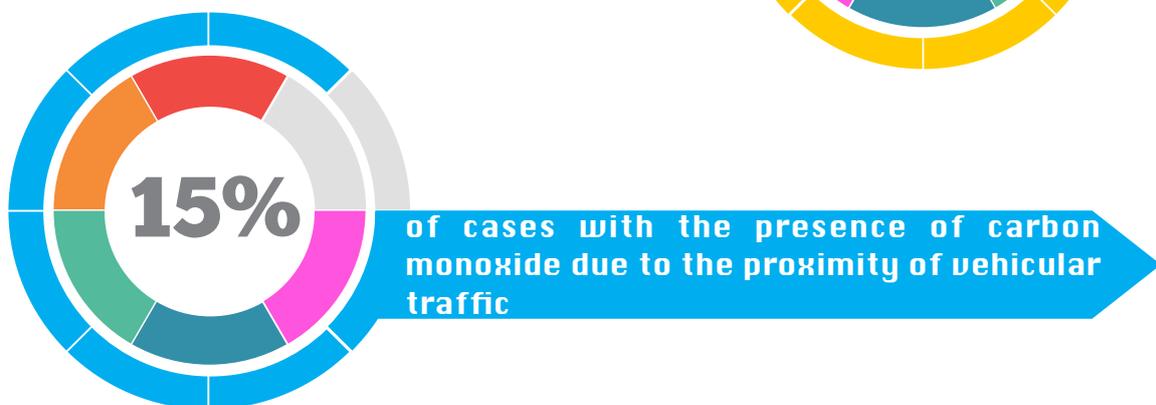
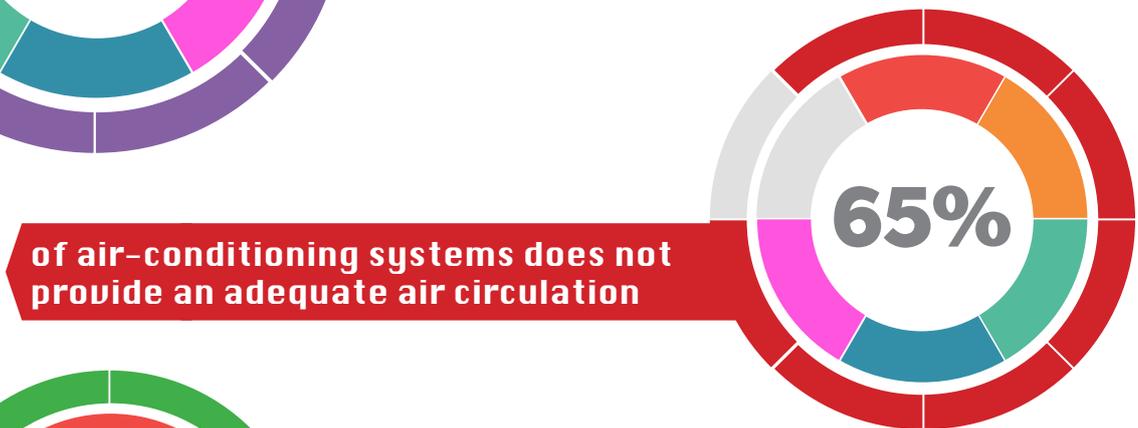
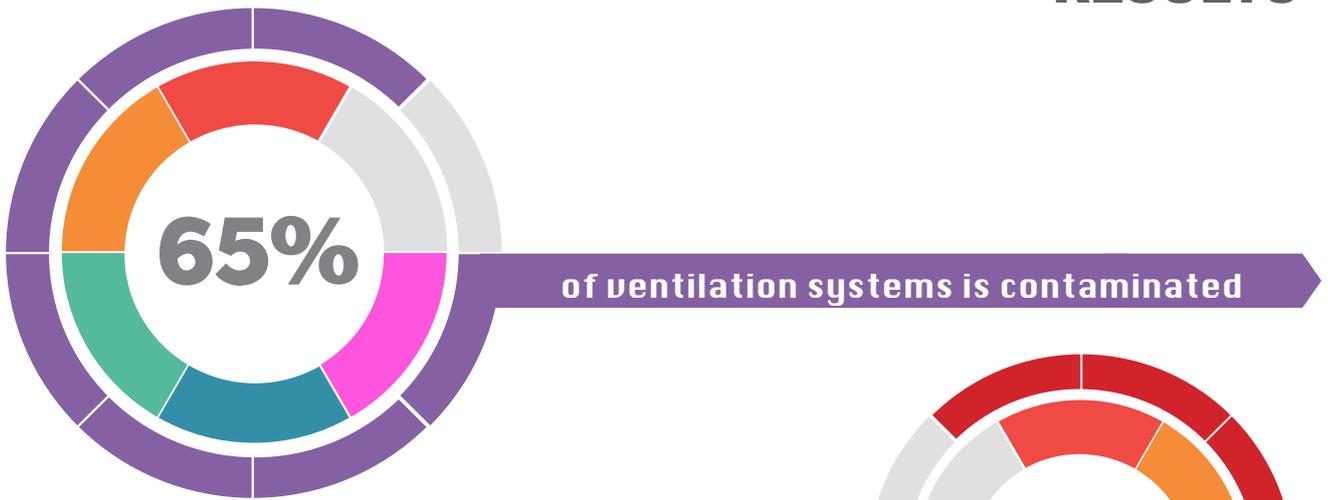
**In this specific phase we have had the opportunity to check how the air quality of the daily environment is actually strongly associated with different human psycho-physical aspects and how they are related to the daily well-being.**



Note: the results of the sampling above, as well as the instrumental scientific documentation, is kept inside the association area of Centro Tutela Cittadino.



# RESULTS



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# PRINCIPALI FONTI DI INQUINAMENTO INDOOR

According to the Health Minister, the substances able to alter the indoor air quality can be classified as chemical, physical and biological agents; they partly come from outside (pollution, fine dust, atmospheric dust, pollen...), but many of them are produced by external sources.

The main indoor sources of pollution are represented by occupants (man, animals), dust, structures, building materials, furnishings, plants (air conditioners, humidifiers, plumbing).

The screenshot shows the website of the Italian Ministry of Health (Ministero della Salute). The main banner features the text "NUOVO CORONAVIRUS Cosa c'è da sapere" with a search bar and social media icons. Below the banner is a navigation menu with categories like "La nostra salute", "Temi e professioni", "News e media", and "Ministro e Ministero". The main content area is titled "Principali inquinanti indoor e loro fonti" and includes a sub-header "Agenti inquinanti e loro fonti" with tabs for "Agenti chimici", "Agenti biologici", and "Agenti fisici". The text discusses indoor air quality, mentioning chemical, physical, and biological agents, and their sources like occupants, dust, and building materials. It also includes sections for "Bioeffluenti e contaminanti biologici" and "Processi di combustione". On the right side, there are sections for "Eventi" and "Vedi anche" with links to related content.

**Principali inquinanti indoor e loro fonti**

I temi di questa sezione sono a cura di: [Direzione generale della prevenzione sanitaria](#)

Web editing: Daniela Sorli

**Agenti inquinanti e loro fonti**

Agenti chimici | Agenti biologici | Agenti fisici

Le sostanze in grado di alterare la qualità dell'aria indoor possono essere classificate come: **agenti chimici, fisici e biologici**, provengono in parte dall'esterno (inquinamento atmosferico outdoor, pollini), ma molti sono prodotti da fonti interne.

Le principali fonti interne di inquinamento sono rappresentate da: occupanti (uomo, animali), polvere (ottimo ricettacolo per i microrganismi), strutture, materiali edili, arredi, impianti (condizionatori, umidificatori, impianti idraulici) e aria esterna.

**Bioeffluenti e contaminanti biologici**

Il corpo umano può emettere composti chimici i cosiddetti **bioeffluenti**, che non raggiungono quasi mai delle concentrazioni nocive per la salute, molti sono caratterizzati da un odore sgradevole.

Generalmente all'aumentare del numero delle persone presenti in un ambiente confinato e in assenza di adeguata ventilazione, aumenta l'insoddisfazione degli occupanti a causa del progressivo deterioramento della qualità dell'aria (aria viziata), che può essere percepita come più o meno sgradevole a causa dall'aumento della concentrazione dei bioeffluenti. L'anidride carbonica (CO<sub>2</sub>), principale gas metabolico prodotto dall'uomo, è utilizzata come indicatore della qualità dell'aria in ambiente indoor.

Le persone sono anche sorgenti di **contaminanti biologici** attraverso la desquamazione dell'epidermide e, soprattutto, l'emissione di goccioline salive: le "goccioline di flügge" immesse nell'ambiente con la fonazione, la tosse o lo starnuto. Queste sono in grado di rimanere sospese in aria e veicolare agenti infettivi di numerose malattie. Anche gli animali domestici sono fonti di inquinamento biologico attraverso la perdita di peli, forfora, saliva, urine ecc.

**Processi di combustione**

Molte attività degli occupanti contribuiscono a inquinare l'aria degli ambienti chiusi. Uno dei fattori principali è il fumo di tabacco passivo (ETS), oltre ai processi di combustione di persona, gas, cherosene, carbone e legno.

Ricerche di chimica analitica hanno dimostrato che il fumo di tabacco passivo (ETS) contribuisce all'inquinamento degli ambienti chiusi poiché apporta significative concentrazioni di nicotina, sostanze irritanti, tossiche e cancerogene.

I processi di combustione per la cottura dei cibi e il riscaldamento degli ambienti contribuiscono all'aumento della concentrazione di ossido e biossido di azoto (NO ed NO<sub>2</sub>), anidride carbonica (CO<sub>2</sub>) e monossido di carbonio (CO). Recentemente è aumentato l'interesse della comunità scientifica nei confronti dei fenomeni di inquinamento indoor connessi alla combustione delle biomasse, soprattutto per la maggiore diffusione di stufe a legna e caminetti, in relazione alla crisi economica e alle politiche energetiche che ne incentivano l'impiego.

Da questo tipo di combustione derivano emissioni di inquinanti chimici pericolosi, come: monossido di carbonio (CO), composti organici volatili (COV), particolato fine carbonioso (PM<sub>10</sub>) e idrocarburi policiclici aromatici (IPA).

**Eventi**

**Ambienti di vita e salute - dalle evidenze di impatto sanitario agli obiettivi prestazionali**  
Data evento: 9 - novembre 2018

**Vedi anche**

- Aria Indoor - Impatto dell'inquinamento indoor sulla salute della popolazione
- Aria Indoor - Sindrome dell'edificio malato - Sick building syndrome
- Aria Indoor - Malattie associate agli edifici - Building related illness
- Aria Indoor - Effetti della qualità dell'aria indoor su salute e comfort ambientale
- Aria Indoor - Microclima e benessere termico
- Aria Indoor - Qualità dell'aria Indoor

**Cambia canale**

News e Media

- Campagna di comunicazione contro il tabagismo - 2015
- Campagna di informazione online Aria di primavera - 2014
- Inquinamento Indoor, il vademecum del'ISS



Tabella - Principali agenti indoor e potenziali fonti interne

FONTI	INQUINANTI
Processi di combustione a gas o carbone per riscaldare e/o cucinare, camini e stufe a legna, gas di scarico veicoli	Prodotti di combustione (CO, NOx, SO2, particolato)
Materiali da costruzione e isolanti	amianto, fibre vetrose artificiali, Particolato, Radon; Agenti biologici (per presenza di umidità e/o polvere)
Materiali di rivestimento e moquette	formaldeide, acrilati, COV e Agenti biologici (per presenza di umidità e/o polvere)
Arredi	formaldeide, COV e Agenti biologici (per presenza di umidità e/o polvere)
Liquidi e prodotti per la pulizia	alcoli, fenoli, COV
Fotocopiatrici	ozono (O3), polvere di toner, idrocarburi volatili (COV)
Fumo di sigaretta	Idrocarburi policiclici, COV formaldeide, CO, particolato fine
Impianti di condizionamento	CO <sub>2</sub> e COV (per scarso numero di ricambi orari o eccesso di riciclo); Agenti biologici (per mancanza di pulizia/manutenzione)
Polvere	Agenti biologici (allergeni indoor: acari)
Individuali	CO <sub>2</sub> e Agenti biologici (batteri, virus ecc.)
Animali	Allergeni indoor (peli ecc)
Sorgenti naturali (lave, tufi, graniti, ecc.)	Radon



Usually, as the number of people present in a confined space increases and in absence of a proper ventilation, occupants' dissatisfaction, caused by progressive deterioration of air quality (stale air), which can be perceived unpleasant due to the increased concentration of bio-effluents, increases as well.

Carbon dioxide (CO<sub>2</sub>), the main metabolic gas man-made, is used as indicator of the air quality in indoor environment.

People are also sources of biological contaminants through skin desquamation and, above all, the emission of saliva droplets: "Flügge droplets" released into the environment through phonation, cough or sneezing. These are able to remain suspended in air, carrying infectious agents of many diseases. Even pets are sources of biological pollution through hair loss, dandruff, saliva, urine etc

## ACTIVITIES OF OCCUPANTS

### **Combustion processes**

Many activities of the occupants contribute to pollute the air of closed environments. One of the main factors is environmental tobacco **SMOKE** (ETS), in addition to combustion processes of oil, gas, kerosene, coal and wood.

Researches of analytical chemistry have shown that environmental tobacco smoke (ETS) contributes to the pollution of closed environments, since it brings significant concentrations of nicotine and irritant, toxic and carcinogenic substances.

Combustion processes for **COOKING FOOD** and space **HEATING** contribute to increase the concentration of Nitrogen Oxide and Dioxide (NO and NO<sub>2</sub>), carbon dioxide (CO<sub>2</sub>) and carbon monoxide (CO).

The interest among the scientific community towards phenomena of indoor pollution related to biomass burning, especially because of the increased availability of wood stove and fireplaces, has increased recently.

Emissions of **dangerous chemical pollutants**, as **Carbon Monoxide** (CO), **Volatile Organic Compounds** (VOC), **Fine Carbonaceous Particles** (soot) **and Polycyclic Aromatic Hydrocarbons** (PAH), result from this kind of combustion.

Other indoor potential sources of pollution are domestic cleaning and maintenance products, pesticides and the use of adhesives, stickers, solvents etc.

In addition, the use of work tools as printers, plotter and photocopiers may cause an important emission of pollutants.



# BIOLOGICAL AND CHEMICAL POLLUTION



Air-conditioning systems may represent dangerous sources of biological and chemical pollution, especially when they are in a bad state of cleaning and maintenance. Colonies of micro-organisms may lurk and multiply in plants where there is stagnant water, such as humidifiers and air conditioners, vaporizers, heating systems, fridges with auto defrost, water plants.

Moreover, a wrong location of air intakes in close proximity of high pollution areas, like busy roads, parkings or garages, can determine the ingress of pollutants from the outside.

The particulate matter expelled by exhaust gases of city vehicles, PM10 and PM2.5 (5-10 times smaller than the thickness of a hair), the smaller it is, the more alarming is to humans: HEART AND LUNGS ARE THE FIRST TARGETS, SINCE THE PARTICULATE MATTER IS ABLE TO GET INTO THE BLOOD STREAM.

Direct consequences of this continuous exposure, even in places believed to be safe but that they are not, are:

**379.000 cases of ischaemic heart diseases**

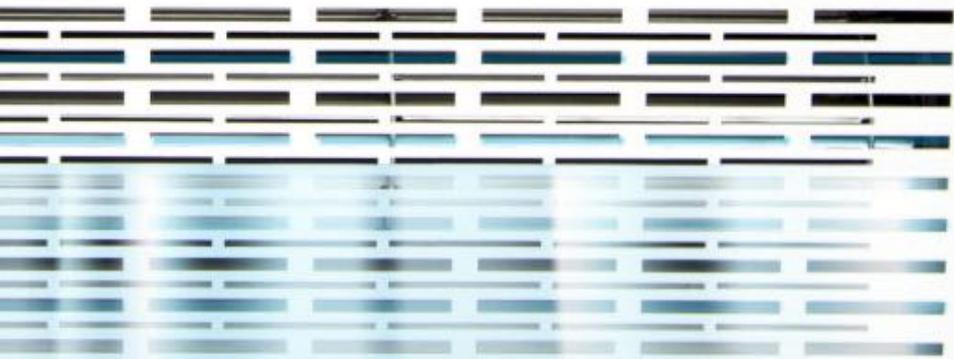
**165.000 cases of infections of the lower respiratory tract**

**36.900 new cases of asthma**

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