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purificarea aerului și a apei

Dezinfectarea incaperilor UV-C, UV-C-Ozon și produse de dezinfectare cu plasmă

Aprilie 2020

Content

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- *Soluții cu plasmă pentru camere în aerul de recirculare* — Dezinfectia aerului
- *Lampă UV-C în unități cu ventilator* — Dezinfectia aerului
- *UV-C/Ozone unitati mobile* — Dezinfectia suprafetelor

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Tehnologia plasmei și posibilitățile de integrare în sistemul de conditionare a aerului

Contextul științific al tehnologiei plasmei

Punerea în aplicare a tehnologiei plasmei in sistemele de conditionare a aerului in industria hoteliera

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Prezentare generala a unităților cu plasmă

1 PRELIMINARY FILTRATION

In the pre-filter, preliminary separation of large pollutants contained in the air occurs. This not only protects the subsequent stages of the installation, but also cleans the air from dust.

2 REACTION AND OXIDATION PROCESSES AT THE PLASMA STAGE

The reaction and oxidation process based on plasma technology starts when an air stream passes through a high voltage/discharge source: the air is saturated with singlet oxygen; carbon compounds are activated or directly react with oxygen. In addition, odours are neutralized.

3 COAL FILTER AS A STORAGE REACTOR

The compounds remaining unoxidized are retained by the carbon filter and oxidized there. The carbon filter in this technology performs the function of a storage reactor, which also contributes to the conversion of ozone into oxygen. This eliminates indoor air pollution by ozone. Activated carbon is regenerated during the process, as a result of which its service life is significantly increased.

Controlul fluxului de aer in "Caseta cu consum redus de energie"

Raport de eficiență pentru dezinfectarea bacteriilor și virușilor în sistemele de ventilație efectuate în prezent la Institutul Fresenius!

FUNCTIONS AND APPLICATIONS

Controlled Living Room Ventilation (KWL) involves incorporating a Freshair or Plasma device into the ventilation ducts. Regardless of what is chosen, it will protect the ducts from contamination with fungal spores and microorganisms, and the cost of hygiene will be significantly reduced. Cleanair Plasma KWL is designed to clean air and neutralize odours.

It effectively deactivates bacteria, viruses, spores of yeast and mould in the air, removing unpleasant odours. For the prevention of various diseases, the removal of fine dust PM 2,5 and cigarette smoke, as well as pollen (98 %) and pathogens, incl. bacteria and viruses (99 %) play a significant role. In addition, odours are neutralized (98 %).

CHARACTERISTICS

- Almost all allergens, bacteria, viruses, mould, pollen and other harmful substances are removed from the air or destroyed
- Absence of ozone in rooms
- Multi-stage design: pre-filter, plasma device, activated carbon
- 120 mm diameter of input and output flanges
- Power consumption of only 20 watts
- Long-term health care through improved microclimate

Tehnologia plasmei va fi implementată în diferite carcase pentru diferite aplicații, dimensiuni și nevoi

Instalare fixă: Unitate cu ventilator echipată cu unitate de plasmă pentru aerul de retur pentru a anihilarea virușilor

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Proiectare în funcție de spatiu

FUNCTIONS AND APPLICATIONS

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TECHNICAL DATA

Product name	Suitable for, m^3/h	Power supply, W	Dimensions, mm (L x H x D)	Weight, kg
CAP KWL 250	250	20	600 x 300 x 300	12

- Unitatea de plasmă este dezvoltată pentru “caseta cu consum redus de energie" pentru a evita acumularea de bacterii și virusi in aerul de recirculare
- Integrarea în unitatea ventilatata sau în stațiile centrale de tratare a aerului este posibilă
- Ciclul de viață al electronilor plasmatici este nelimitat
- Design se adapteaza spatiului

Unitatea de plasmă menține numărul de bacterii în aer la un nivel scăzut

Funcționarea unităților cu plasmă este o soluție suplimentară pentru camere și parțial pentru zonele publice și reprezintă o siguranță suplimentară în afară de lămpile UV integrate în cadrul unităților de tratare a aerului

Instalare fixă pentru aerul de retur al casetei cu consum redus de energie

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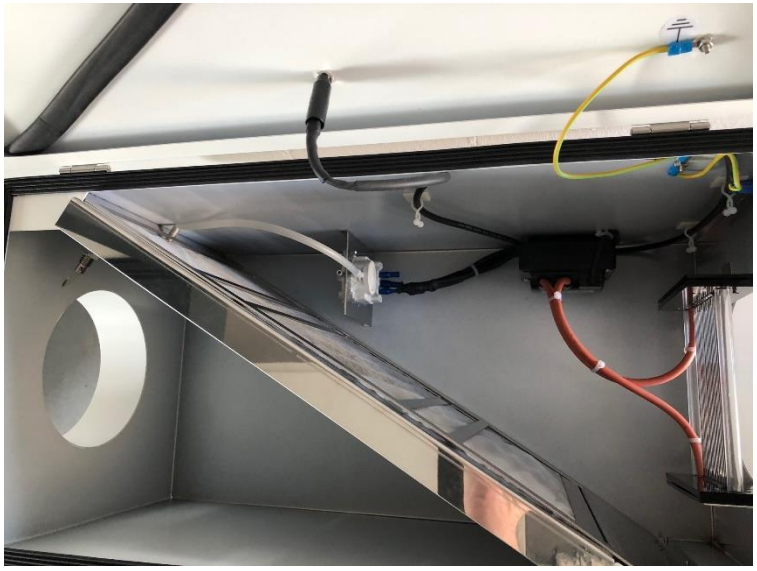

- *Tehnologia plasmei și posibilitățile de integrare în sistemul ventilat*
- *Contextul științific al tehnologiei plasmei*

Inactivation of a Foodborne Norovirus Outbreak Strain with Nonthermal Atmospheric Pressure Plasma

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ABSTRACT Human norovirus (NoV) is the most frequent cause of epidemic nonbacterial acute gastroenteritis worldwide. We investigated the impact of nonthermal or cold atmospheric pressure plasma (CAPP) on the inactivation of a clinical human outbreak NoV, GII.4. Three different dilutions of a NoV-positive stool sample were prepared and subsequently treated with CAPP for various lengths of time, up to 15 min. NoV viral loads were quantified by quantitative real-time reverse transcription PCR (RT-qPCR). Increased CAPP treatment time led to increased NoV reduction; samples treated for the longest time had the lowest viral load. From the initial starting quantity of 2.36×10^4 genomic equivalents/ml, sample exposure to CAPP reduced this value by 1.23 $\log_{10}$ and 1.69 $\log_{10}$ genomic equivalents/ml after 10 and 15 min, respectively ($P < 0.01$). CAPP treatment of surfaces carrying a lower viral load reduced NoV by at least 1 $\log_{10}$ after CAPP exposure for 2 min ($P < 0.05$) and 1 min ($P < 0.05$), respectively. Our results suggest that NoV can be inactivated by CAPP treatment. The lack of cell culture assays prevents our ability to estimate infectivity. It is possible that some detectable, intact virus particles were rendered noninfectious. We conclude that CAPP treatment of surfaces may be a useful strategy to reduce the risk of NoV transmission in crowded environments.

IMPORTANCE Human gastroenteritis is most frequently caused by noroviruses, which are spread person to person and via surfaces, often in facilities with crowds of people. Disinfection of surfaces that come into contact with infected humans is critical for the prevention of cross-contamination and further transmission of the virus. However, effective disinfection cannot be done easily in mass catering environments or health care facilities. We evaluated the efficacy of cold atmospheric pressure plasma, an innovative airborne disinfection method, on surfaces inoculated with norovirus. We used a clinically relevant strain of norovirus from an outbreak in Germany. Cold plasma was able to inactivate the virus on the tested surfaces, suggesting that this method could be used for continuous disinfection of contaminated surfaces. The use of a clinical strain of norovirus strengthens the reliability of our results as it is a strain relevant to outbreaks in humans.

Recently, human norovirus (NoV) infection has been the most commonly identified cause for nonbacterial epidemic gastroenteritis outbreaks in Germany (1). Epidemic outbreaks of NoV occur in communities, military barracks, cruise ships, hospitals, and assisted living communities (2). Over 19 million cases of illness in the United States (3) and 110,000 infections in Germany (1) are verified by laboratory diagnosis each year. The estimated number of unreported cases is considerably higher. Annually, the costs of health care and lost productivity due to foodborne illness caused by NoV account for approximately $2 billion in the United States (3).

Norovirus, a member of the *Caliciviridae* family, is a single-stranded nonenveloped (positive)-stranded icosahedral RNA virus with a diameter of approximately 35 to 39 nm and a high variability of structural proteins in and around the receptor-binding domain. To date, five NoV genogroups (GI to GV) have been described; viruses of genogroups GI, GII, and GIV are known to infect humans. Of those three genogroups, GII most frequently causes human infections. Currently, genogroup GII contains 17 genotypes. GII.4 is the most widespread genotype and predominates in pandemics and outbreaks (2).

Person-to-person transmission is of great importance during NoV outbreaks and can lead to a vast number of infected persons. The infective dose of NoV is very low (4). Furthermore, NoV is extremely stable in the environment, showing resistance to detergent-based cleaning and disinfection with chlorine (5) and heating to 65°C, freezing, and acidification (6, 7). In addition, the matrix of NoV-containing samples may have protective effects on virus survival in inactivation studies (8, 9). Currently, clinical NoV strains can be obtained only using vomitus or feces. Hence, the search for effective disinfectants is highly complicated by these natural substrates.

Contextul științific al tehnologiei plasmei (2/2)

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As an innovative decontamination technology, cold or nonthermal atmospheric pressure plasma (CAPP) can be applied. Plasma is the fourth state of matter, defined as a partially or completely ionized gas that can be generated by applying an electrical field to an initially electrically neutral gas (10). The inactivation of the virus particles functions through synergy effects of the cold plasma-initiated air chemistry, which consists of nitric oxide (NO) (including its intermediates, NO radicals, NO^-, and NO^+, and adducts, NO_2, NO_2^-, NO_3^-, N_2O_3, N_2O_4, and $ONOO^-$) and reactive oxygen species (including ozone, atomic oxygen, singlet oxygen, and oxygen ions, which can have antimicrobial effects). The impact of CAPP on bacteria, some fungi, and yeast was already described by Fridman et al. (11). However, the effects of CAPP on viruses are relatively unexplored (12). In the present study, we used a cold atmosphere pressure plasma device (FlatPlaSter 2.0) to investigate the impact of CAPP on a clinically relevant NoV strain.

To our knowledge, this study represents the first direct treatment of a human NoV, GII.4 from stool suspension, with CAPP. Quantitative real-time reverse transcription PCR (RT-qPCR) of serial dilutions of the samples revealed that initial viral load (VL) was approximately 2.4×10^7 virus particles per ml (Fig. 1). In order to determine the effectiveness of the inactivation of NoV GII.4 by exposure to CAPP, we prepared three different stool dilutions. The quantities of NoV were determined as cycle threshold (C_T) values using RT-qPCR (13) and subsequently converted into genomic equivalents.

We found that increased plasma treatment times led to decreased copy numbers of NoV. In this case, we show log reduction compared to the nontreated sample (Fig. 2; see also Table S2 in the supplemental material). Depending upon the initial viral load, we observed a reduction of up to 1.69 $\log_{10}$ after CAPP treatment ($P < 0.05$). Lower dilutions of the initial stool suspension led to initial starting quantities of 2.36×10^4 genomic equivalents/ml. Here, a statistically significant reduction of virus particles was shown only after exposure to CAPP for 10 and 15 min, which caused 1.23 $\log_{10}$ and 1.69 $\log_{10}$ decreases compared with the control, respectively ($P < 0.01$). In contrast, CAPP treatment of lower starting quantities (subsequent dilutions of the stool suspension) of 1.1×10^3 genomic equivalents/ml and 3.67×10^1 genomic equivalents/ml reduced viral load by at least 10-fold after CAPP exposure for 2 min and 1 min, respectively ($P < 0.05$). Hence, viral load and matrix effects (feces and phosphate-buffered saline

Conclusions. In summary, this is a comprehensive study on the impact of CAPP treatment on human norovirus GII.4. The results showed that CAPP treatment reduced significantly the viral load of NoV; however, the initial viral load may influence the efficacy of CAPP treatment. Thus, regardless of previous dilutions, a significant reduction of approximately 1 $\log_{10}$ step after CAPP treatment of at least 2 min was possible. The RT-qPCR assay has limitations. For example, this assay only detects and quantifies the amount of viral RNA; it does not estimate the viability or infectivity of intact viral particles. The use of an RNase pretreatment helps to control for disrupted viral particles and improves the estimations. CAPP treatment effectively reduced the amount of a clinically relevant outbreak strain, NoV II.4, without any chemical residues.

CAPP1) reduce efectiv focarul de virusi relevant din punct de vedere clinic, fără a produce alte reziduri chimice

1) "Plasmă de presiune atmosferică rece sau netermală (CAPP)" este egală cu punctul terminus oxitec "Plasma Technology“

Date științifice de dimensionare pentru oxidarea plasmei sunt disponibile în prezent doar parțial

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• Astăzi, contextul științific similar cu dezinfecția adica expunerea la UV-C 254 nm (ultraviolete cu frecventa undelor de 254 nm) tehnologia , pe baza de studii se aplica in mediile care afecteaza calitatea vietii umane .

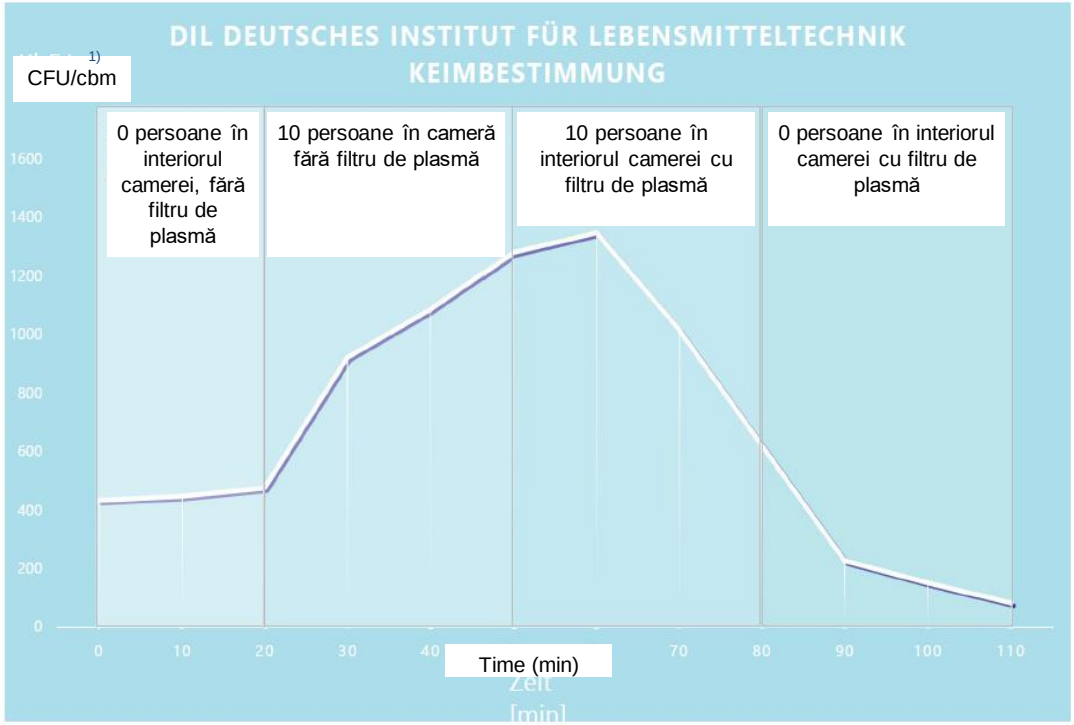
• In mod current, universitati specializate studiaza folosirea plasmei reci, CAPP (Cold Atmospheric Pressure Plasma) in scopul de dezinfectie .

• Parametrii relevanti pentru dimensionarea sistemelor cu plasmă sunt:

- Volumul de aer
- procentul de recirculare a aerului
- temperature aerului
- procentul de umiditate a aerului
- nivelul de praf
- dimensiunea si volumul camerelor
- calitatea organica a aerului (atestata de laboratoare specializate)
- numarul si frecventa miscarii oaspetilor si personalului in spatiul respectiv

DIL Institutul German pentru Tehnologia Alimentară

Controlul bacteriilor



1) CFU = Colony Forming Units (nr de colonii de bacterii/mc)

Teste care trebuie efectuate de institute externe – de exemplu, așa a făcut în prezent Fresenius pentru Case cu consum redus de energie pentru compania Viebrockhaus

Content

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Dezinfectia aerului

- *Soluții cu plasmă pentru casetele de ventilatie in zonele cu recirculare a aerului*

Dezinfectia aerului

- *Lampi UV-C in unitatile de ventilatie*

Dezinfectia suprafetelor

- *Unitati mobile UV-C cu Ozon pentru dezinfectie aer si suprafete*

Instalare fixă: Unitate ventilator echipată cu lampă UV de 254 nm

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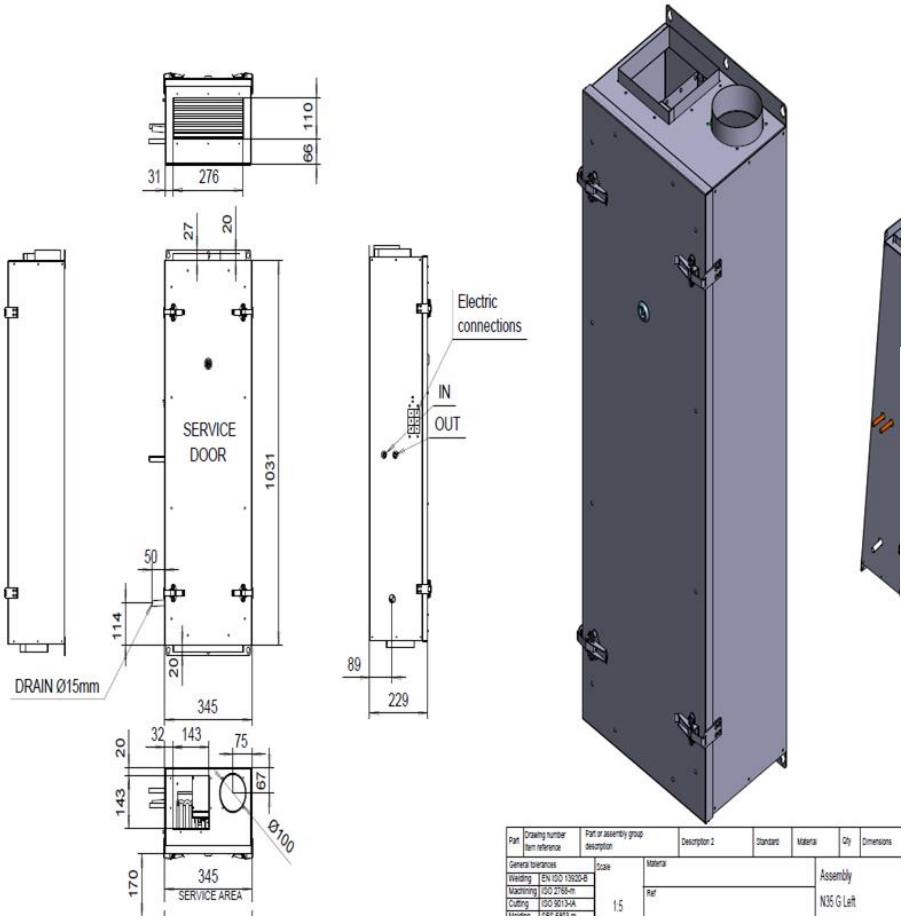

- Integrarea lămpii în unitatea ventilatorului
- Lampa UV-C asigură reducerea bacteriilor și a virusului în fluxul de aer
- Pret de 300 to 500 EUR/ unit, approx. 60 Watt/ lamp
- Atenție: Viteza aerului să fie luata în considerare!
- **Lampa va fi schimbată la 12.000 - 16.000 de ore de functionare**

Unitatea UV-C menține numărul bacteriilor în aer la un nivel scăzut

Lampa poate functiona 24/7

Unitati mobile/ Tehnici de igenizare

Contextul științific al ozonului

Unitati mobile Saniair 125/250/400:
Curățarea aerului camerei – dezinfectarea cu ozon a suprafețelor

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caracteristici

- Dispozitiv de curățare a aerului din cameră , încărcat cu germeni
- Distruge în mod eficient bacterii, viruși, drojdii, ciuperci și sporii din aer și pe toate suprafețele
- Potrivit ca dispozitiv de decontaminare
- Lucreaza independent de sistemul de conditionare a caladirii
- Volum de aer decontaminat 40 to 160 m^3

Inteligent ca natura - ozonul

- Detergent natural
- Dezinfectant eficient
- Procedura validată
- Reduce mirosurile
- **Nu sunt permise persoane și alte fiinte vii în cameră.**

Aplicatii

- Camere
- Magazii
- Bucatarii
- Vestiare
- Camere de fumat
- Camere frigorifice
- SPA-uri si zone wellness
- Sali de fitness
- Camioane si containere de transport alimente…

Rezultate:

- efficient si rapid
- De asemenea, curăță locurile, care nu sunt accesibile (de ex. nișe)
- Camerele dezinfectate pot fi folosite rapid
- Nu dezvolta o rezistența germenilor
- Nu se utilizarea substanțelor chimice sau a filtrelor
- Fără reziduri (de ex, Nox, oxizi de nitrogen, gaz poluant)

Unități mobile Saniair 125/250/400
Caracteristici tehnice

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Saniair 125/250/400

Saniair for odor removal and rapid disinfection without presence of people in the room. The Saniair air cleaner works with UV-C light and a higher amount of pure ozone. It removes quickly and efficiently microorganisms, bacteria, viruses and odors in the air and on surfaces.

Technical data Saniair 125/250/400

Dimension	446 x 133 x 135 mm 446 x 133 x 135 mm 460 x 200 x 250 mm
Power consumption	30/50/100 Watt
Suitable for (Odor)	100/250/500 m³
Suitable for (Disinfection)	13/25/40 m³

Ozonul generat nu este la un nivel atât de ridicat, încât garniturile, cauciucul, suprafețele etc. sa poata fi deteriorate

Procedura de curățare: se configurează o strategie individuală de dezinfecție

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Saniair 125/ 250/ 400 poate fi utilizat pentru dezinfectarea camerelor. Dezinfectarea poate fi în conformitate cu următoarea procedură:

- Ferestrele si usa camerei se inched ;
- Ventilatorul sistemului de conditionare a aerului se inchide;
- Saniair 400 va functiona timp de 1 ore cu ventilatorul de recirculare a aerului pornit

Se adapteaza in functie de camera

După finalizarea acestei proceduri camera se va aerisii/ventila timp de 30 de minute. După 30 de minute 50m3 de aer proaspăt va fi suficient pentru a relua activitatea in camera

Testarea este necesară după dezinfectare?

- Se recomandă să se testeze dupa prima dezinfectie pentru a scrie o procedură individuală de calitate pentru fiecare tip de camera;
- Pe baza unui studiu, un laborator specializat va efectua, documente de calitate , proceduri și actiuni ce pot fi stabilite pt fiecare zona/tip de camera . Pe baza acestora, o procedura check-clean va fi "la îndemână" pt fiecare zone;

În cele din urmă – rezultatul testului ne poate arata ca procedura a fost prea scurtă sau prea lungă. Pe baza constatărilor se va stabilii strategia corespunzătoare de dezinfectare.

În cazul în care testarea este necesară, ceea ce ar trebui să fie testate, banci, mobilier sau conducte de aprovizionare?

- Recomandare: Diferite locuri în interiorul camerei. În plus, priza de aer și orificiul de admisie a aerului .

Atenție: dezinfectare cu ozon nu înlocuiește procedurile de cleaning/curățare mecanică a camerei

Curățarea/purificarea aerului camerei – climă mai bună cu Freshair / Multiair cu temporizator

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Caracteristici

- Dispozitiv de curatare/purificare a aerului static din incaperi;
- Distruge în mod eficient bacterii, virusi, drojdii și sporii din aer și de pe suprafețe
- Lucreaza independent de sistemul de conditionarea a aerului;
- Pentru 15-60 m³;
- Utilizare mobila sau montat pe perete;
- Fără emisie de radiatii în afara dispozitivului, inofensivă pentru produse, animale și persoane

Inteligent ca natura

- **Ozon in concentratie <0,04 ppm**
- Procedura validată
- Persoanele pot rămâne în cameră
- O mai bună atmosfera in cameră

Aplicaţii

- Camere încărcate cu germeni
- Camere pentru alergici
- Vestiare, wc
- Ghena de gunoi
- Containere
- Incinte pt fumat

Results

- **Continuous operation possible (< 0,04 ppm) with attendance of people**
- nu dezvolta rezistenta la germeni
- nu foloseste filtre chimice
- consum redus de energie
- instalare usoara,
- fara reziduri poluante (ex Nox, oxizi de nitrogen)

Implementarea unităților în camere cu ventilatie slaba

Unitati mobileFreshair/ Multiair: Caracteristici tehnice

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Freshair

The Freshair works with UV light and a small amount of ozone. The ozone produced is below the threshold value of 17.5 mg / h, which is below the natural concentration of ozone. It is therefore safe for humans and animals. Available in many colors and different shapes..

Multiair 250

The Multiair 250 combines the services and advantages of the Saniair and the Freshair in one device: It can be used both for the rapid disinfection of indoor air and in continuous operation (Freshair mode), depending on whether there are present people in the area to be treated or not. The desired mode is set using a security key.
The compact device is also available with a timer function. The user can determine the start and end of the process without being on site.

Technical data Freshair

Dimension (L x Ø – round housing) (L x W x H – square housing)	 380 x 129 mm 340 x 98 x 98 mm
Power consumption	25 Watt
Suitable for	15 – 60 m³

Technical data Multiair 250/Multiair 250 Timer

Dimension	450 x 180 x 200 mm
Power consumption	60 Watt
Suitable for (Odor)	250 m³
Suitable for (Disinfection)	25 m³

Contextul științific al ozonului

Oxidare fotolitica 185 nm:
Studiile relevă eficiența dezinfecției ozonului

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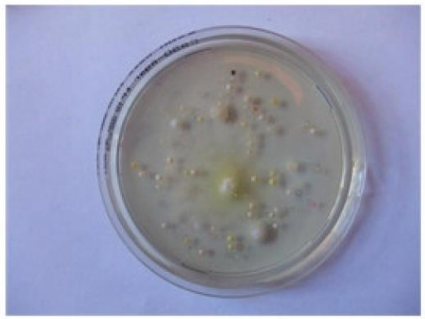
4.1.4 Evaluation

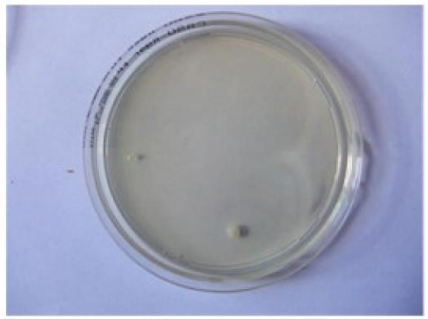
Bacteria and mould fungus concentration found in ambient air is 10 KbE/m³ and 230 KbE/m³, respectively. In comparison to this mould fungus concentration in room no. 1 is almost 22 times higher. In room no. 1 bacteriological concentration exceeds 5 times the value registered in ambient air.
This clearly shows the appearance of germination inside the building. It becomes clear that mainly condensers but also other parts such as suspension track conveyors, door seals and damaged packings are directly involved in this major problem.

Compared to this UV-C -Ozone treatment of the air led to a total elimination of mould fungus after operating the APM[1)] for a period of 2 hours. The concentration of bacteria was reduced from an initial value of 940 to 20 CFU/m³, which corresponds to a reduction rate of 98%.
Due the relatively high concentration of germs in compartment air, compared to the values measured in ambient air, it is recommended to perform a complete cleaning of all condensers, door seals and technical installations such as suspension track conveyors, repeating this procedure every 6 months. When registering warm humid atmospheric conditions, e.g. in autumn, the low ambient air concentrations increase, impacting on internal air. The results of the UV-C/ozone treatment show however clearly that this kind of reduction offers an optimal solution in accordance to the germs found in this company; therefore UV-C technique with ozone treatment should be taken into consideration as a possibility for a long-term solution. Ozone concentration must be controlled to accomplish industrial safety and food hygiene regulations.

Bacteria (R1 MP01) prior to ozone



Bacteria (R1 MP06) after ozone



Toate studiile efectuate de oxytec subliniază eficiența dezinfecției ozonului.

DAR

Dezinfectia cu ozon nu înlocuiește curățarea mecanică –
dar servește ca o garanție pentru eliminarea virușilor și bacteriilor în locuri dificil de curățat

1) echipamentul Sanipro 2000

Oxidarea fotoliică 185 nm: Studiile științifice dovedesc eficiența ozonului contra diferitelor bacterii Escheri Coli și MRSA

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Tratarea aerului înconjurător cu lumină UV-C și ozon elimină rapid și foarte eficient germenii, mucegaiurile, sporii și mirosurile.

Avantaje :

- Eficiente chiar și în locuri dificil de ajuns
- Camerele dezinfectate pot fi ocupate după o perioadă scurtă de timp
- nu se formeaza rezistenta la germeni
- nu se folosesc chimicale, (ex. Clor)
- nu formeaza condens

În timpul utilizării, de obicei nu trebuie să existe persoane în cameră.

În timpul unui proces de validare de către Labor für Mikrobiologie und Hygiene in Hoyerswerda (raport de testare nr. 11410, iunie 2015), a fost testat efectul ozonului împotriva diferitelor microorganisme. În concluzie, s-ar putea dovedi un efect antimicrobian și bactericid al ozonului împotriva germenilor Aspergillus niger, MRSA Staphylococcus aureus și Escherichia coli.

Proben-Nr. Labor 2015/	Proben-Bezeichnung	*Escherichia coli* [in Anlehnung an ASU B 80.00-3] resultierendes Wachstum auf dem Nährboden nach 2 d [KbE / cm²]
05/76-15	*Escherichia coli* Positivkontrolle Ausgangskonzentration: $2{,}8*10^5$ KbE / cm²	$2{,}8*10^5$
05/76-16	*Escherichia coli* Fenster a Ausgangskonzentration: $2{,}8*10^5$ KbE / cm²	<1
05/76-17	*Escherichia coli* Fenster b Ausgangskonzentration: $2{,}8*10^5$ KbE / cm²	<1
05/76-18	*Escherichia coli* Wand a Ausgangskonzentration: $2{,}8*10^5$ KbE / cm²	0
05/76-19	*Escherichia coli* Wand b Ausgangskonzentration: $2{,}8*10^5$ KbE / cm²	0
05/76-20	*Escherichia coli* Boden a Ausgangskonzentration: $2{,}8*10^5$ KbE / cm²	<1
05/76-21	*Escherichia coli* Boden b Ausgangskonzentration: $2{,}8*10^5$ KbE / cm²	0

Hinweise zu den Tabellen:

Datorită unui "potențial ridicat de oxidare" a ozonului, dezinfectarea cu ozon depaseste eficiența detergenților chimici