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CLIMATE ENVIRONMENTS IN TIME OF COVID – 19: TREATMENT AND PURIFICATION OF THE CLIMATIZED AIR AGAINST COVID, THROUGH AIR PURIFICATORS AND APPLICATION OF UV LAMPS

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Abstract: Air-conditioned environments in the midst of a pandemic has become one of the concerns for everyday life, because it has a high risk of contamination by SARS-Cov-2, due to one of its forms of transmission being through humans. It was established to do this air renewal to contribute to the fight against COVID-19, in closed environments with high, turnover. The pandemic had a great socioeconomic impact, in the search for safe solutions for the return of activities and reduction of economic losses, safe and economically viable methods were implemented to guarantee air quality through purification through equipment intended for this purpose. The equipment that will be used for this air purification process are: Safe Air air purifier with HEPA filter, G4 antimicrobial filter, UV lamps that will be in the tray and air conditioner coil to avoid the bio-film that promotes the proliferation of fungi and bacteria in the exchanger module and the photo ionizing equipment that will be found in the air conditioning ducts, it has PHI (Photo Hydro Ionizer) technology, which will contribute to the reduction of odors, emergence of microorganisms such as viruses, fungi, bacteria and the reduction of cross-contamination, with its proven effectiveness in up to 99%.
Keywords: Air renewal, Equipment, Microorganisms.

INTRODUCTION

The SARS-CoV-2 virus, belonging to the family of coronaviridae, which causes the disease called COVID-19, was detected on December 31, 2019 in China. Causer of respiratory infections, it has a broad clinical spectrum, since its infection ranges from asymptomatic cases to severe pneumonies that result in death [9,10,13].

Classified as highly transmissible, the infection by the coronavirus took place at about four weeks after the first cases of contagion were categorized as a global emergency epidemic, two months later the World Health Organization announced the beginning of the Covid-19 pandemic. 19 [7,13].

The means of transmission of the coronavirus are multiple, the main one occurring among humans, as the virus remains active in the environment in the aerosol form for at least 3 hours, according to studies carried out by Dr. Van Doremalen, Ph.D. Trenton Bushmaker, B.Sc. National Institute of Allergy and Infectious Diseases and collaborators (Aerosol and surface stability of SARS-CoV-2 compared to SARS-CoV-1). Other studies have revealed that, very often, the contamination of the air inside the environments is much higher than the levels outside. In view of the above, a concern was created with the transmission of the virus through the air and scientific studies concluded the high risk of contamination by SARS-Cov-2 in air-conditioned environments that do not have an adequate system for renewing and treating the air. Consequently, it was established that one of the pillars of the fight against COVID-19 would be the renewal of air in closed environments, emphasizing closed environments with high turnover [8,9,13].

The coronavirus pandemic had great socioeconomic impacts, as, by government determination, there were lockdown protocols, use of mask, use of gel alcohol and social distancing, to reduce cases of contamination, in addition to having changed the whole routine of our planet, as a result, it generated unemployment, closing companies, closing activities, etc. Seeking the return of commercial activities and the reduction of economic losses, the population has been looking for several ways to stay healthy, following protocols that the government has stipulated, due to the new daily life it was

necessary to implement safe and economically viable methods. to ensure air quality, through the treatment and purification of air conditioning [7,8,9]. In this research it will be proposed the installation and operation of devices for the treatment of the return air of the acclimatized system in an office. The equipment used to reduce the concentration of viruses, bacteria and microorganisms will be:

1 - Safe Air air purifiers;

2 – G4 Antimicrobial Filters;

3 – UV lamps;

4 - Photo-ionizing equipment.

AIR AND EQUIPMENT RENEWAL

Air renewal is an important criterion to be considered when designing air-conditioned environments, with the aim of purifying indoor air quality, there are several national regulations. Due to the presence of this respiratory disease, transmitted through the air, air-conditioned environments that do not have an adequate system of renewal and air treatment become risky, contributing to the increase in the transmission of this disease. In Brazil, the standardization is made by NBR 16401-3. Air conditioning installations, in general, rely only on the renewal of air through infiltration through gaps in doors, windows, through the entry and exit of people [3, 6].

Mechanical renovation is more present in environments equipped with a central air conditioning system and in installations that follow regulations. When the environment is equipped with split-type air conditioning or even window models, it is not uncommon to have additional equipment such as ventilation cabinets or exhaust fans/air blowers. It is important to clarify that it is possible to install air renewal equipment in environments that do not currently have them, but there are some precautions that must be observed. For mechanical air renewal in environments that will be adapted, it is necessary to assess the impact of injecting outside air, which will have a higher temperature, and whether the current equipment will withstand the consequent increase in the thermal load. Because the existing system installed may not be prepared for a new heat source coming from the outside, because its installation was designed in a different context. The in-insertion of outside air with the frequency required in the current circumstance of high risk of contamination by the SARS-Cov-2 virus, being the complete exchange of the ambient air several times per hour, having the ability to increase the thermal load of the environment greater than the installed air conditioning projects behave. The environments that were not created thinking about the new reality of facing a pandemic with strong signs of air transmission, it is necessary to ensure that there is enough power to achieve the proposed objectives [3,12].

UV radiation corresponds to the portion of the electromagnetic spectrum that lies between X-rays and visible light. The germicidal effect of ultraviolet light was first detected in 1878 and has since been developed and used for disinfecting objects and environments, among other applications. The spectrum of UV light varies between 100 nm and 400 nm. Within the electromagnetic spectrum, the wavelengths with the most efficient germicidal action are those from 100 nm to 280 nm present in UV-C lamps [2,6,11].

The disinfecting action of UV-C lamps occurs through the energetic photons of light that break the chemical bonds of the genetic material of microorganisms, leading to inactivation, death or inability to reproduce. Research shows the possibility of using UV-C radiation effectively to control airborne germs. It is important to emphasize that the relative humidity of the air has an influence on the process, the susceptibilities of microorganisms

to UV-C at 80% relative humidity were lower than those found at 50% relative humidity. (With UV light will work Tray and fan-coil coil) [2,6,11].

MATERIALS AND METHODS

Based on information from existing equipment on the market, its functions were used for the operation and effectiveness of this research. The system will be designed according to the capacity, need and dimensions of the environment to be served. The materials used in this research were the following:

1. Safe Air air purifiers: air purification equipment will be installed in the engine room before the return of the HVAC equipment, with the same air flow, with UV-C lamp, G4 pre-filter (2") and HEPA filter located internally, capable of capturing particles from a size of 0.3 microns, thus preventing contaminated particles from remaining in the air. With voltages of 127V and 220V, with a G4 filter and a weight of up to 1.5 kg, it produces low noise and has 3 speeds that result in three different flows: 850, 1700 and 2550m^3/h [4].

2. G4 Antimicrobial Filters: it will replace the conventional ones of the return coil of the equipment, being a disposable filter that comes in two sizes, supplied in flat carton, zig zag carton, cut or roll, it is a filtering medium in synthetic fibers -thetics with high powder accumulation capacity and low pressure drop, has an antimicrobial treatment that inhibits growth and eliminates spores, bacteria, fungi and algae.

3. UV lamps: it will be used on the fan coil tray and coil to prevent the biofilm that promotes the proliferation of fungi and bacteria in the exchanger module, preventing the growth, normally developed on damp surfaces. Constant use of UV light ensures better cleaning of the coil without generating chemical residues, as it avoids manual cleaning, generating savings. UV radiation eliminates the formation of mold in the air conditioning system, reduces viruses and bacteria, preventing their multiplication. It disinfects the air that passes through the air conditioning system [2,6,11].

4. Photo ionizing equipment: it will be installed in the insufflation ducts, having the PHI (Photo Hydro Ionization) technology, it provides a reduction of microorganisms, viruses, bacteria and fungi, reduces cross-contamination. Producing ionized hydrogen peroxide gas in the air, eliminating up to 99% of airborne pathogens [5,7].

The air sterilization system was implemented to work in a network of ducts, which will be accessed by returning to the engine room, passing through the air purifier that contains a HEPA filter. Upon entering the machine, it will pass through the G4 antimicrobial filter and UV lamps, and upon entering the ducts, it will pass through the air purifier that contains PHI (Photo Hydro Ionization) technology. TAE (outdoor air intake) will be implemented in the system, from which the air entering the engine room will carry out the entire air purification cycle when entering the refrigeration equipment.

The figure below outlines the operation of the system in question and its stages:

The result of a test was verified that was carried out at Innovative Bioanalys-is Laboratories in Cypress, California (USA), beginning in March 2020 supervised by Dr. James Marsden - Executive Director of Science and Technology at RGF. Equipment with PHI (Photo Hydro Ionized-ra) technology, has the effectiveness of eliminating particles of the SARS-Cov-2 virus in the ducts of the HVAC

system through air purification units by up to 99.9% [1,5].

The test was done inside a large chamber, which had HEPA filtered exhaust inlets with active UV-C system in all plumbing lines, representing an office or a house with air conditioning in the real world. No outside air was brought in during the test and the inlet remained sealed. The virus was nebulized in space by a programmable compressor system, simulating a sneeze or cough of an infected person. The test showed that the airborne SARS-Cov-2 virus was neutralized within the occupied environment, reducing the risk of person-to-person respiratory particle and aerosol infection. The PHI technology equipment used in the test helps to eliminate viral particles that pass through the filter of the HVAC system or UV air purification system [1,5].

RESULTS ANALYSIS

The results of the test carried out by Innovative Bioanalysis Laboratories with the UV-C system with PHI technology, demonstrated a progressive reduction of the active virus after 5 minutes of exposure in the form of an aerosol. SARS-CoV-2 virus was not detected alive at the 20 minute time point, (levels were below 120 TCID50/ml limit of quantification. This would equate to a 4 log reduction compared to control values in 2 minutes, there was an 83.6% reduction in the active pathogens recoverable in the air. After 10 minutes of exposure in the chamber, there was a reduction of 99.99% in the active pathogens recoverable in the air. Initial concentration of active SARS-CoV-2 virus, the aerosolized volume, it can be assumed that the probability of entering an environment with this amount of pathogen in a real-life circumstance is unlikely. There was a large amount of sterilization achieved by the UV system in the first 5 minutes. The reduction of airborne collectable viruses was significant over the 10 minutes. Overall, the assembled UV system device showed effectiveness in destroying SARS-CoV-2 in the air, and for possible mutations [1,5].

FINAL CONSIDERATIONS

The risk of SARS-CoV-2 contamination in closed environments and without any air purification has become a major concern, as living in this type of climate-controlled environment without adequate air renewal has become one of the major contributors to the increase of cases of contamination by SARS-CoV-2. The need arose to look for ways to live in closed and air-conditioned places. In search of this, the market started to offer many equipments that provide the elimination of SARS-CoV-2 and the reduction of contamination by it, through technology such as air purification with G4 antimicrobial filters, UV lamps and technology PHI (Photo Hydro Ionization), guaranteeing the conviviality of people in the closed environment without risks to health. Making it possible for many activities to return and showing the importance of air renewal, whether by contamination by SARS-CoV-2 or any other viral agent. The study carried out inside a chamber mentioned in this work, which simulates a house or office, obtained the efficient result of the technology that will be increased in the air purification system discussed in this content, it will obtain effectiveness for possible mutations of the SARS-CoV-2 virus.

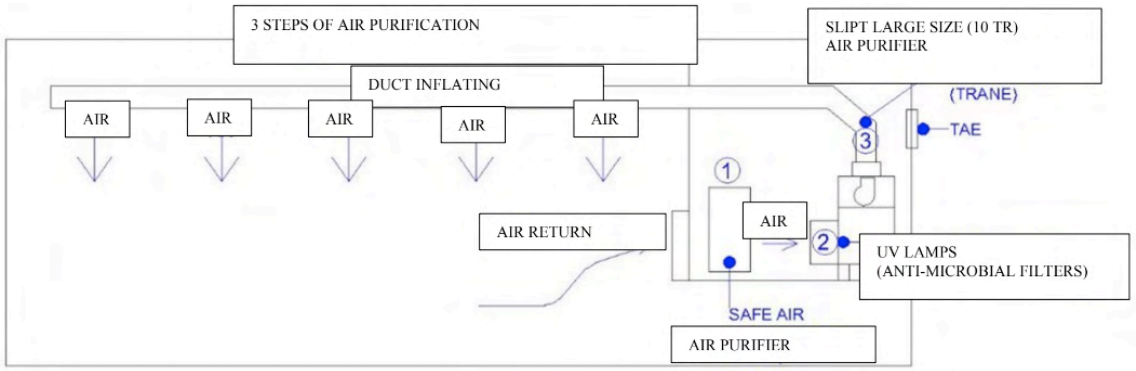
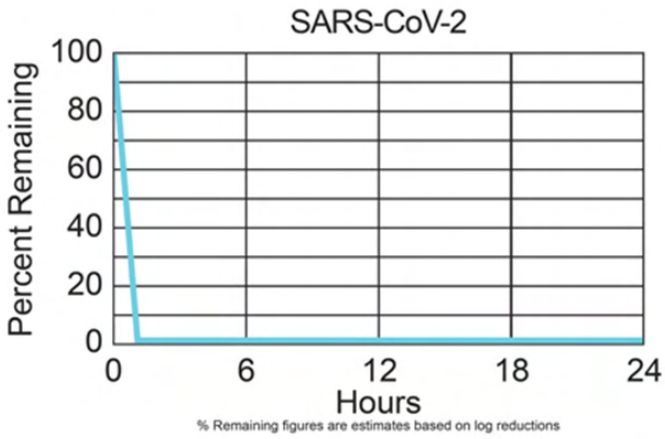


Figure 01: Schematic of the 3 stages of air purification (Done by the author himself).



Picture 01: Test summary 99.9%, in hours. Study done by Dr. James Marsden at Innovative Bio-nalysis Laboratories.

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