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Design of Ultraviolet Germicidal Irradiation System

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ABSTRACT: Ultraviolet germicidal irradiation (UVGI) is a disinfection method that uses short-wavelength ultraviolet (ultraviolet C or UV-C) light to kill or inactivate microorganisms by destroying nucleic acids and disrupting their DNA, A modular germicidal light grid system is used inside an air conditioning unit that has a section through which a stream of air is passed. The system comprises of one lamp assembly and one linear germicidal light Source.UVGI systems use much more concentrated levels of ultraviolet energy than are found in sunlight. The kill rate of pathogens and other microorganisms using UVGI depends on several factors, including UVGI intensity, the number of microorganisms present, and the amount of time the microorganisms are present in the UVGI Zone, or dwell time. Generally, kill rate increases as the UVGI

KEYWORDS: ultraviolet germicidal irradiation system,virus,UVGI,microorganisms,airconditioning, inaactive

I. INTRODUCTION

Clean and pure air is of utmost importance nowadays. In this pandemic situation, fresh air is most important factor, that's why we have use "Ultraviolet germicidal irradiation system". The present invention relates to an ultraviolet germicidal irradiation system for use in residential, commercial, and industrial heating, ventilation, and air-conditioning ("HVAC") application Contaminated air in buildings and homes is now an international issue. Certain airborne contaminants cause wide spread discomfort and health problems, leading to absenteeism from School and work, as well as reduced productivity. This system uses short wave ultraviolet (UVC) energy to inactivate virtual, bacterial & fungal organisms so they are unable to relicate & potentially causes diseases like covid-19, tuberculosis , asthma etc. Healthy and productive indoor environment would save billions of dollars in health care.

ULTRAVIOLET GERMICIDAL IRRADIATION SYSTEM PROCEDURE

Nicholas G. Reed in the international commission on illumination (CTE 2003) defines the UV portion of the electromagnetic spectrum as radiation having wavelength between 100 and 400nm. The UV spectrum is further divided into UVA (Wavelength of 400 to 315nm), UVB(315 to 280nm), UVC(280 to 200nm) and vaccuum UV(200 to 100nm) (IESNA 2000). Downes A, Blunt TP in 1877 'Downes and blunt' discovered the ability of sunlight to prevent microbial growth. It is later shown that the ability light to inactivate microorganisms is dependent on the close (intensity × time) and wavelength of radiation and the sensitivity of specific type of organisms. Horne explained one particular value or range of the UV light rays can be used for disinfecting purpose.

Sameer A. Bilal explained system equipped with UV light can also be used to eliminate fungii accumulated on the cooling coil and filter surface. Kowalski W.J summarizes the costs associated with purchasing, installing, and operating UVGI systems and describes the current state of UVGI technology, future directions for technology development, including the use of lamps produced from nontoxic materials and light-emitting diode lamps.

Contaminated air in buildings and homes is now an international issue. Certain airborne contaminants cause wide spread discomfort and health problems, leading to absentee ism from School and work, as well as reduced productivity. Healthy and productive indoor environments would save billions of dollars in health care costs, lost work time, overall output and possible litigation. Of the many contaminants found in indoor air, bio-aerosols are regarded as the leading cause of allergies and other mala dies referred to as SBS (Sick Building Syndrome) and BRI (Building-Related Illness). Bio-aerosols are airborne products that include microorganisms, their fragments and spores, metabolic gases, and other toxins and waste products. Numerous studies have found high concentrations of these bio-aero sols both in air handling equipment and the interiors they SWC. Airborne and surface microorganisms include pathogens, allergens, and toxins. Included in the category of pathogens are viruses, bacteria, and mold, which could cause measles, chicken pox, Legionnaires disease, aspergillosis, tuberculosis, and other infectious disease. Bacteria and mold are also classified as allergens because they can cause allergic rhinitis, asthma, humidifier fever and hypersensitivity pneumonitis. Toxins include mycotoxins and endotoxins, which can cause toxic and allergic reactions, irritations, and odors. Among allergens, mold and mold products are probably the most common worldwide. Allergy tests universally bear out this phenomenon. In HVAC equipment, mold can proliferate year-round. With most individuals, prolonged exposure to mold and mold products initiates the release of histamines, causing inflammation of mucous membranes, which can be followed by congestion, breathing difficulties, asthma and other respiratory complications. Conventional HVAC systems are an ideal source and con duit for the origin and/or spread of microorganisms. Their environments are especially conducive to amplifying molds and some bacteria. The fans of the HVAC system disseminate and/or recirculate system, space and occupant-generated microorganisms room to room and person to person. Conventional filtration assemblies of such HVAC systems are com promised because growth typically occurs downstream of filters, which allows microorganisms to seed in the ductwork and travel to and throughout the occupied space. Additionally, viruses and many bacteria are too small to be captured by a common air filter. Traditional bioaerosol controls tend to be impractical, toxic, detrimental to equipment operation, and costly. Hence, the industry has turned to ultraviolet germicidal irradiation (“UVGI) for the sterilization of microorganisms. In HVAC systems, the application of UVGI in the air handling unit cooling coil and filter assemblies is effective in reducing the number of microorganisms. Additionally, the constant irradiation exposure has been found to be effective at controlling fungal growth. Microbes are uniquely vulnerable to the effects of light at wavelengths at or near 2537 Angstroms, due to the resonance of this wavelength with molecular structures. A quantum of energy of ultraviolet light at these wavelengths possesses an amount of energy Sufficient to break organic molecular bonds, which damages the cellular structure of the microorganisms. The ultraviolet component of Sunlight is the main reason microbes die in the outdoor air. The die off-rate in the outdoors varies from one pathogen to another, but can be anywhere from a few seconds to a few minutes in order to kill 90 to 99% of viruses and contagious bacteria. Spores and some environ mental bacteria tend to be resistant and can survive much longer exposure.

UVGI SYSTEM IN AIR CONDITIONING UNIT

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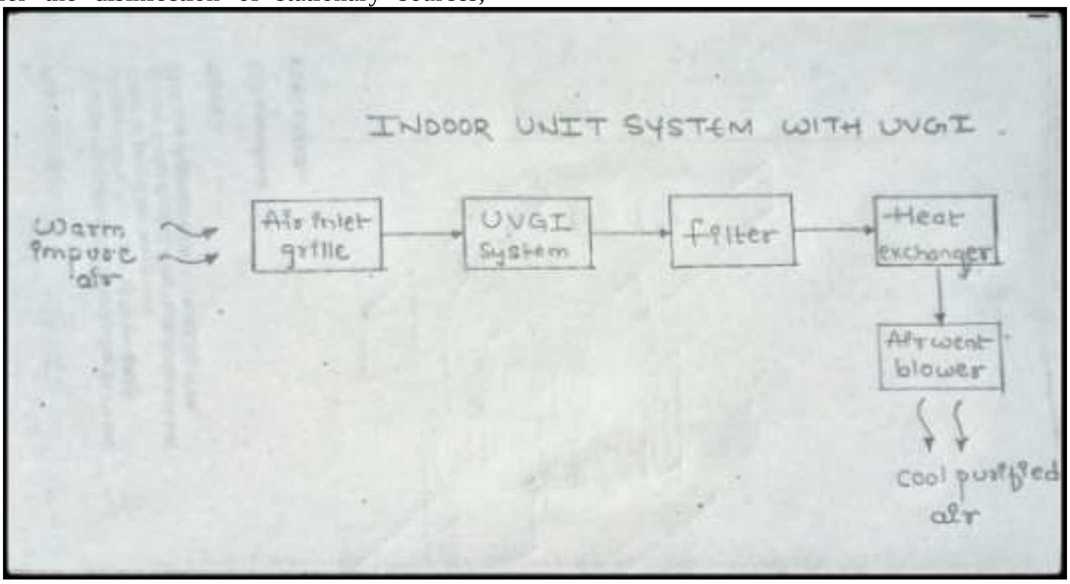
II. EXPERIMENTATION

Also disclosed is a performance standard for the measuring UVGI in a germicidal light grid system. These UVGI factors are calculated using the Inverse Square Law, which can be written wherein I is the intensity of the influence, S is the source strength and r is the distance from the Source. For convenience, four levels of performance capability are disclosed. They are as follows:

Level 1: Minimum UVGI factor of 9.
Level 2: Minimum UVGI factor of 16.
Level 3: Minimum UVGI factor of 36.

Level 4: Minimum UVGI factor of 144. The primary function of a system at Level 1 is the surface disinfection of stationary devices. The secondary function of Level 1 is for the deactivation of microbial agents in dynamic motion within a moving airstream. For the purpose of ease of discussion, in this and all of the following discussions regard ing performance capabilities, we assume that there are two germicidal light sources 70 per lamp assembly 50 and that the light sources used are the aforementioned Philips™ germicidal lamps. As such, in one example, the spacing of the germicidal light sources 70 along the elongate second member 26 is about 48" in order to maintain a UVGI factor of 9. Exemplary spacing between germicidal light sources 70 on separate elongate second members 26 is about 24" in order to maintain a UVGI factor of 9. The primary function of Level 2 capability is for the deactivation of microbial agents in dynamic motion within a moving airstream. The secondary function of Level 2 is for the disinfection of stationary sources, typically air-handling system components. In one example, Vertical spacing of the germicidal light sources along the elongate second member is about 36" in order to maintain a UVGI factor of 16. Exemplary spacing between germicidal light Sources on separate elongate second members is about 18" in order to maintain a UVGI factor of 16. The primary function of Level 3 capability is for the deac tivation of microbial and pathogenic agents in dynamic motion within a moving airstream. The secondary function of Level 3 is for surface disinfection of stationary devices, typi cally mission critical process filtration air-handling system components. For example, Vertical spacing of the germicidal light sources along the elongate second member is about 24" in order to maintain a UVGI factor of 36. Exemplary spacing between germicidal light sources on separate elongate second members is about 12" in order to maintain a UVGI factor of 36. The primary function of Level 4 capability is for the deac tivation of microbial and pathogenic agents in dynamic motion within an airstream. The secondary function of Level 4 is for Surface disinfection of stationary devices, typically mission critical process filtration air-handling system com ponents. In one example, vertical spacing of the germicidal light sources along the elongate second member is about 12" in order to maintain a UVGI factor of 144. Here, the germi cidal lamps on separate elongate second members are crossed, with an example being between them of about 6" in order to maintain a UVGI factor of 144.



LINE DIAGRAM OF UVGI SYSTEM

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III. EXPERIMENTAL SETUP & WORKING

1. Ultraviolet germicidal irradiation (UVGI) is a disinfection method that uses 254 nanometre Ultraviolet light to kill micro-organisms.
2. It is effective in destroying the nucleic acids in these organisms so that their DNA is disrupted, leaving them unable to perform vital cellular functions.
3. UVGI Systems proactively remove the bio-films (layer of slimy, sticky substance that comprises the mixture of bacteria, mold , etc.), thus ensuring that the air does not get contaminated through the coil and drain pans.
4. Warm air with Impurities and Airborne particles enters through Air inlet grille , the air gets disinfected by UV rays when passing from it.
5. The UVGI system kills the germs and viruses present in the inlet air , Futher in the system the air-filter filter out the air impurities (dust).
6. The blower then blows out clean and purified cool air into the space.

UVGI AND THE FUTURE OF DISEASE CONTROL

UVGI has a definite future in the control of contagious diseases and if applied on a widespread basis, it may be the key to controlling epidemics and pandemics. No other current technology has the capability, the adaptability, and the favorable economies to make it viable for an extremely wide variety of disease control applications. It is already used extensively and effectively in water applications and in surface disinfection applications. In combination with air filtration, it is the most effective and economic technology for disinfecting air. From health care applications to schools and residential environments, UVGI holds the promise of one day contributing in a major fashion to the eradication of many contagious diseases. The advent of multidrug-resistant microbes like MRSA and XTB, and emerging pathogens like SARS and Avian Influenza is likely to stimulate the increased use of UVGI systems in an ever wider number of applications, The contribution UV technology can make to the control of epidemics is amenable to analysis by the statist cal models of epidemiology, which have demonstrated the potential for widespread use of UVGI systems to theoretically halt contagious airborne disease epidemics Kowalski 2006). Perhaps continued research and development will ultimately lead to UVGI becoming a standard component of ventilation systems in all indoor environments and this age of airborne epidemies will come to an end.

AIR DISINFECTION

Airborne pathogens and allergens present a much greater threat to human health than water-based microbes, in terms of total incidence and net costs of health care, but there are far fewer air disinfection systems in place than water disinfection sys tems, and much less information is available for airborne UV disinfection than for water applications. The success of UVGI for air disinfection application has also been subject to much interpretation and even outright dismissal, In spite of repeated demonstrations of its effectiveness. After decades of research, the field of airborne UV disinfection remains fraught with unknowns and misconceptions, and applica tions are far less numerous than they perhaps should be. The subsequent chapters attempt to consolidate the entire knowledge base relevant to UVGI and to demon strate how the careful application of proper design principles and new approaches can produce results as predictable and reliable as those of water disinfection sys tems. New computational methods, combined with a wealth of recent design and installation experience and ongoing research, now allows systems to be installed with fairly high levels of confidence in terms of their performance.

Methods for demonstrating in place performance, along with various guidelines and standards for such installations, have brought the field of UVGI from an uncer tain art to a nearly complete science. The key missing component at this time is conclusive evidence that UVGI air disinfection reduces the incidence of airborne disease, a matter that will require years of data collection, once there are sufficient and adequate installations available for monitoring. Some current studies are explor ing this avenue of research and preliminary results suggest that UVGI is, as theory and analysis predicts, effective in reducing both the symptoms and incidence of various airborne diseases. As applications increase, this database should eventually provide reliable evidence that may lead to full economic justification of UVGI lestallations in health care facilities, schools, and other types of buildings, The widespread use of UV for air disinfection in buildings is likely an eventuality that will pay economic and health dividends to future generations.

IV. CONCLUSION

Ultraviolet germicidal irradiation (UVGI) is a disinfection method that uses short-wavelength ultraviolet (ultraviolet C or UV-C) light to kill or inactivate microorganisms by destroying nucleic acids and disrupting their DNA, leaving them unable to perform vital cellular functions. UVGI is used in a variety of applications, such as food, air, and water purification. UV-C light is weak at the Earth's surface since the ozone layer of the atmosphere blocks it. UVGI devices can produce strong enough UV-C light in circulating air or water systems to make them inhospitable environments to microorganisms such as bacteria, viruses, molds, and other pathogens. UVGI is coupled with a filtration system to sanitize air . The application of UVGI to disinfection has been an accepted practice since the mid-20th century. It has been used primarily in medical sanitation and sterile work facilities. UVGI has found renewed application in air purifiers.

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