WORLD LIFE - COVID-19 and CURRENT AND FUTURE IMPACTS OF COVID19 VIRUS

GENERAL EVALUATION

It has been known for years that viruses and bacteria derange health and are a threat to human life. Right from the start of its existence, humankind has been attacked by viruses and bacteria, millions have lost their lives due to a number of epidemics and pandemics that went down in history, and even, due to such outbreaks, states collapsed, new political movements emerged, wars were won or lost. In other words, the world experienced radical changes to impact its future.

For some of many pandemics including plague, cholera, typhus, HIV, ebola, bird flu, Hong Kong flu, Spanish flu, H2N1, SARS, MERS, etc., vaccines were developed, and for some, life-extending treatments were found.

As to a significant majority of these diseases, they faded in time, although an effective and full treatment still remains undeveloped even today. However, it is a known and witnessed scientific fact that outbreaks may start to jeopardize human life again after temporary eradication, due to life-threatening mutations and in the form of repetitive attacks.

Authorities let everyone know about the precautions and sterilization measures to be taken for prevention from the pandemics they were exposed to, based on the scientific methods available in the time, expected people and institutions to take measures in a way to be affected by the pandemics as little as possible, and, in a sense, tried to redesign the way of life to be able to defeat the novel problem they were facing.

However, the gospel truth is that humans' ability to develop immunity and mutate to be able to survive is extremely slow and insufficient compared to their bacterial enemies, and therefore have always been caught unawares by these attacks and, in a manner of speaking, struggled to survive after being shot. Moreover, this fact will change neither today nor in the future, due to the ability of bacteria, viruses, and humans to hold onto life and the presence/form of the means that improve/drive this ability, and humanity will always be caught unawares by a surprise attack/outbreak.

It is best evidenced by the recent pandemic caused by the virus named 2019-nCoV, with which the humankind has been recently acquainted, despite the tremendous advancement of science and technology, and which paralyzed life simultaneously throughout the world, halting and damaging commercial, economic, daily and social activities all together.

In this regard, COVID-19 outbreak may be the most important one of the pandemics ever and the one that has bore the most serious consequences in that it caused a global damage simultaneously and in every domain.

This pandemic has undermined all values of humankind that have developed and reached the present day, challenged the common knowledge and routines, and succeeded in turning the life upside down, globally.

Therefore, COVID-19 pandemic has;

1- Broken commercial chain that developed in the course of history and used to be operable, Brought the world trade and all the elements connected to the economic chain that makes up this trade to the verge of irreparable destruction and even annihilation unless a solution is found in a short time,

2- Forced the state authorities, who exert effort to keep the pandemic under control by social isolation, making people stay at home, to subsidize the economic loss caused by the measures taken and rendered the authority of those, who failed to come up with a permanent solution in the medium term, vulnerable and questionable.

3- Brought the social life, work-life, and family life to the brink of extinction. Paved the way for psychological exhaustion to be suffered by each member of the society due to the lack of such values. In addition, it ruled out the income generated by daily business life and also caused the companies to take a bath or declare bankruptcy because of their ongoing costs.

4- The current shock wave caused concerns and fear amongst the public, saying "what if this will be the permanent state of affairs, what if we lost all our savings and assets..." and discouraged individuals or organizations to invest and trade. In addition to this trend of thought, the outbreak, and the economic damage and uncertainties it caused disturbed the balance of debts, receivables, and payments so much that the daily business life has almost come to a halt.

5- There are signs that the feeling of despair may become gradually permanent both for the individuals and the corporations. Now, the disturbance of social, corporate and individual peace is a probability because of the panic that may arise once this state of mind starts to dominate people. The disease made it predictible that the states, which fail to properly manage the process and provide their people a normal life as soon as possible, will lose their power over people and official authorities may have to deal with revolts, insurrections, internal disturbances, civil commotions or anarchist actions because certain values have got harmed.

6- Since the pandemic primarily harmed education and health sectors and business life, a fear emerged in the society concerning the current and future extent and quality of permanent healthcare services. There are uncertainties about the supply of educated employees such as doctors, scientists, engineers, architects, etc., should the current state of affairs last for longer. The pandemic also raised concerns about how states and individuals, who generate income through activities that involve transportation of goods and services, will manage to survive since such activities are on hold now and free movement of the needed labor force has become impossible.

In addition to all, although efforts have already been initiated to develop a therapeutic vaccine for the current COVID-19 pandemic we all have witnessed; relevant institutions, individuals and experts state that

- development of a vaccine will take at least one year.

- They also mention unpromising definite treatment success rates of the vaccine like 50-60%.

- Even if a treatment/vaccine was found, the 2019-nCoV virus which can and is expected to mutate and other viruses with a similar effect may threaten human health and human life again and again.

- Bearing this in mind, whatever their names and species are, new viruses and bacteria that might pop up at any moment require at least two or three years for humans to build up immunity, but

at the end of this period, still, they may not be immune. Thus, the best way to fight these viruses and bacteria, according to experts, is to avoid being exposed to them, take measures to prevent transmission, develop new and efficient sterilization methods, and reconfigure social life accordingly by introducing new standards in every domain to complete the transformation process without getting infected.

Otherwise, it is clear that societies/states will jeopardize their own existence or risk being ignored since they fail to fulfil the criteria required for integrating with the world unless they manage to introduce new standards and procedures to life, which is required by the viruses that obstruct/halt life in every aspect, and thus make many essential activities such as official procedures, daily life, transport, trade, education and so on impossible.

Therefore, the most crucial transformation that we should undergo to be protected from the viral and bacterial outbreaks, which we are and will be facing under different names and forms and will be caught unawares by, is to introduce new standards to ensure sterilization at homes, schools, hospitals, cafes, barracks, police stations, public offices, hotels and other touristic facilities, sport halls, means of transportation etc., and to use handy, effective, cost-efficient sterilization tools to ensure these standarts will be followed.

In the light of current developments, it must be stated that:

A) It is the people and the society that makes up a state, a nation, and an authority. Thus, the authorities should provide conditions to help society sustain their current lifestyle as soon as possible. On the other hand, they need to take measures to be prepared for future outbreaks and similar future pandemics, and complete the preparations that are essential to redesign life accordingly.

B) Otherwise, the course of events signals that official authorities who fail in this regard may lose their reputation before the public and face serious problems once they lose the love and loyalty of the people.

C) Considering the monetary policies and financial instruments that are operable in the global order, it is a crystal-clear fact that official authorities cannot end this fight and meet society's needs just by issuing money and thus cannot attain the instruments to ensure the coexistence of people.

D) Whatever the reason is, however, the political and economical life evolves in the future, whatever our power/impact is in this evolution process, what should be done today and the only way to save the authorities and humankind from this difficult position is to help us turn back to normal life in a way to sustain our current living conditions and, to this end, to protect the peace environment both financially and socially by redesigning the functioning of life urgently.

Gersan AŞ has always valued technological investments and R&D activities and implemented technologies to ensure quick recovery from the state that has been created by the COVID-19 outbreak and be prepared against similar situations to be the case in the future, and launched new generation products it has produced that will help people rapidly turn back to their normal life.

The goods produced by our company, which have the necessary qualities to help humankind and societies turn back to their routine, appeal to a wide range of consumers, from individuals to public or private institutions.

In addition, our products are easy to use, functional in that they do not require maintenance and repair, with low acquisition costs, and yield good results and have many advantages.

Details and brief technical information about our products, the technological infrastructure for which has been completed and production of which has been initiated by our company, can be found below/attached.

Please note that you can always get in touch with our company officials to acquire full information when required. We are open to cooperation and ready to provide assistance in every field and wish for a world where we all live in good health, peace, and happily.

Kind regards.

Hasan Basri Coskun

What is COVID-19?

The virus causing coronavirus disease 2019 (COVID-19) is not the same as the coronaviruses that commonly circulate among humans.

Severe Acute Respirator Syndrome Coronavirus 2 (SARS-COV-2) is the newly discovered coronavirus responsible for the 2019 novel coronavirus disease (COVID-19). This new virus and disease were unknown before the outbreak began in Wuhan, China, in December 2019.

How Does COVID-19 Spread?

As a result of the researches, experts state that COVID-19 virus has the ability to transmit so quickly through breathing, contact and can live

According to the CDC, Coronaviruses are generally thought to spread from person-to-person through respiratory droplets. It may be possible that a person can get COVID-19 by touching a surface or object that has the virus on it and then touching their own mouth, nose, or possibly their eyes, but this is not thought to be the main way the virus spreads.

Although experts explain that each individual should not get closer than 1.5 - 2 meters and this social distance should absolutely be protected in order to reduce the risk of infection, the same experts also state that this distance should be at least 9 - 10 meters (approximately 27 feet) even in open environment in order to be protected from viruses that may spread from the sneeze and/or cough of an infected patient.

Within the context of the life shaped within this framework, experts underline the importance of disinfestations processes, maintaining social distance, and avoiding every place where people come together collectively.

How long does the coronavirus live on different surfaces?

- 4 hours on copper,
- 24 hours on carton (1 day),
- From 2 -3 days to 6 days on steel - stainless steel and plastic,
- 3 days on glass surfaces and banknotes,
- 3 hours on printed papers and processed papers such as handkerchiefs,
- 1 day on wood and fabric,
- 7 days outside the surgical mask,
- 3 hours in the air,
- 10 days in faucet (domestic) water, 100 days in wastewater.
- …

How Do UVC LEDs Disinfect Pathogens?

UVC energy is absorbed by nucleic acids inside the RNA and DNA, resulting in covalent bonds which at the right dose can render the pathogen unable to reproduce and infect. The most effective germicidal wavelength occurs with a peak between 260 nm to 275 nm, the point at which DNA absorbs UV energy the most.

UVC energy is a commonly used sterilization technology that has been shown to inactivate a wide range of pathogens (e.g. MRSA, C. diff, E. Coli and Pseudomonas). For many years, UV mercury lamps were considered the best choice. However, lamps have several limitations, including low activity at refrigeration temperatures, fragile construction, long warm-up time, risk of mercury exposure, and limited UV emittance at 254 nm. In comparison, UV light-emitting diodes (UV LEDs) can be configured to emit at ideal germicidal wavelengths and provide reliable on-demand disinfection without the limitations which hamper mercury lamps.

Are UVC LEDs Effective Against COVID-19 (Coronavirus)?

As evident by multiple research studies and reports, when biological organisms are exposed to deep UV light in the range of 200 nm to 300 nm it is absorbed by DNA, RNA, and proteins.

Absorption by proteins can lead to rupture of cell walls and death of the organism. Absorption by DNA or RNA (specifically by thymine bases) is known to cause inactivation of the DNA or RNA double helix strands through the formation of thymine dimers. If enough of these dimers are created in DNA, the DNA replication process is disrupted, and the cell cannot replicate.

So, studies have confirmed that UVC light can be effective for combating SARS-COV (source).

HOW DOES GERSAN UVC DISINFECTION WORK?

1 – SURFACE DISINFECTION WITH GERSAN UV LEDS

Contaminated surfaces are everywhere— hospital rooms and equipment, living rooms, airports, and virtually any public place etc. While efforts are made to properly disinfect they often fall short of total elimination of the most virulent contaminants.

Disinfection is the process of reducing the number of viable microorganisms and can also be referred to as “sanitization.” This differs from sterilization which is the process for killing all microorganisms commonly achieved by heat or harsh chemicals reserved for critical care medical instruments which enter sterile tissue or fluids.

Ultraviolet germicidal irradiation (UVGI) is a disinfection method where UVC light is used to inactivate microorganisms by disrupting their DNA/RNA and leaving them unable to reproduce.

Why UVC disinfection?

Almost all current surface disinfection methods use chemical agents. Chemical disinfection can be confusing and inconsistent because of the many products available. To ensure proper disinfection, the selected agent, manner of use (immersion vs contact) and the treatment time must be correctly and consistently applied.

Deep ultraviolet light, albiet in the form of germicidal mercury lamps, has been used and proven over the past 100 years to be effective as part of a high level disinfection protocols.

UVC LEDs offer a solution for next generation devices to employ the benefits of UVC surface disinfection. UVC LEDs are compact, durable and well suited to battery powered operation for point-of-care tools and mobile and fixed all disinfection equipments.

Mobile – portable Gersan UV leds, it is placed at a suitable angle for the place to be sterilized or it is operated with RF remote control by focusing on the object to be sterilized. Thus, the risk of users being exposed to UV beam is eliminated.

Stationary Gersan UV products are fixed to the places where it is desired to be sterilized when the space is empty with automation support and / or installed in places desired to be sterilized so that users can activate manually from a distance when the space is empty.

2 - AIR DISINFECTION WITH GERSAN UV LEDS

Population growth compounded with rapid urbanization has amplified the potential for bacteria and viruses to spread quickly. UVC LEDs can improve indoor air quality and decrease infections.

A rapidly expanding global population is placing a strain on industry and energy infrastructures resulting in a decrease in air quality and increase in associated deaths. In 2015, air pollution caused almost 4 million deaths. *(Only according to the data recorded.)*

In addition, millions of people infect one another and infect numerous diseases and viruses.

Disinfection Methods.

Air purifiers remove particles and other pollutants from indoor air using cartridge filters to trap contaminants. These High Efficiency Particulate Air (HEPA) filters are capable of removing 99.97 percent of airborne particles, however HEPA filters do not remove the volatile organic compounds or small pathogenic micro-organisms, like influenza (viruses).

Widely used humidifiers add moisture to the air to prevent irritation of the skin, nose, throat and lips. However, humidifier reservoirs require frequent maintenance to avoid the formation of bacteria and mold which can contaminate air. Current devices depend on preventive maintenance using chemical cleansers which can damage humidifier material and result in residual odor.

Why UVC disinfection?

Traditional UVGI systems are based on germicidal mercury lamps. Though effective, these systems do not scale well in terms of size, performance and cost to address the needs of consumers. In contrast the compact, high intensity, on-demand operation of UVC LEDs permits compact innovative designs where the LED can last for the lifetime of the appliance.

3 – WATER DISINFECTION UV LEDS.

Expanding and increasingly dense urban populations place tremendous strains on infrastructure and industry—with water demands expected to increase 40 percent by 2030.

Water disinfection is the process of reducing the amount of harmful pathogens in a water supply. This can be achieved through simple chemical, filtration and radiation methods or a combination of techniques.

Chemical disinfectants and treatments are often reserved for municipal and large water distribution networks, while point-of-use (POU) and point-of-entry (POE) systems rely on filtration and deep ultraviolet light (UVC). In these systems, filtration

removes chemical and organic contaminants, while UVC addresses microbial threats from bacteria, viruses and cysts.

Some systems will also combine UVC with photo-catalysts to produce hydroxyl radicals to help remove organic compounds and pharmaceuticals and personal care products (PPCPs).

Why UVC Disinfection?

Once contaminated water has entered municipal distribution systems the health implications, cost and complexity of sanitizing these systems is significant. UVC LEDs can be integrated into on-demand POU water purification systems to protect families and homes from common pathogenic sources of waterborne illnesses.

UVC LEDs are used in these systems to protect against microbial contaminants- including bacteria (E. Coli, Pseudomonas, Legionella), viruses (Rotavirus, Adenovirus, Hepatitis. Covid-19 etc.), and parasites (giardia beaver fever, cryptosporidium).

UVC disinfection remains the sole proven, practical and cost effective solution for addressing true microbial safety without impacting water's odor or taste. Although germicidal mercury lamps have been the trusted UVC source in the past, UVC LEDs are poised to replace them with innovative compact product designs.

Benefits of Gersan Inc. UVC Leds.

UVC disinfection remains the sole proven, practical and cost effective solution for addressing true microbial safety without impacting odor or taste. Historically germicidal mercury lamps have been the trusted UVC source. However, durable UVC LEDs are poised to replace these with innovative compact product designs.

- Disinfects surfaces, air and water at 99.99% guaranteed.
- It destroys bacteria, viruses and other pathogens that harm human health.
- Protects communities and individuals from epidemics. Thus, it plays an important role in the elimination of material and moral damage as a result of outbreaks.
- Proven, maintenance-free true UVC germicidal performance
- On-demand operation to fit user needs and behaviors
- Compact and portable product designs
- Non-toxic, mercury free peace of mind. Zero Toxic Chemical Substances
- The technology is free of mercury and other toxic chemical substances, making it non-toxic and safe to use.
- UV led sterilization products are effective not only for coronavirus but also for all new and different types of viruses and bacteria that have currently mutated and will mutate in the future; and destroy these viruses and bacteria that will harm human health.
- UV Led Sterilization products can remain active 7/24 and are therefore the only option for the constant fight against viruses and bacteria that are harmful to human health.
- It is more environment friendly since water consumption and cleaning chemicals are not used.
- It always works with full performance since it does not necessitate maintenance due to lack of cartridge, filter, etc.
- Usage life of UV LEDs is 60000 hours. It is much more economical than its competitors (maximum 4000 - 6000 hours in UV lamps).
- UVC LEDs are compact, durable and well suited to battery powered operation for point-of-care tools and mobile and fixed all disinfection equipments.
- Gersan UV Led's do not heat up and does not pose a fire risk.
- In addition, Gersan UV LEDs provide proven maintenance-free antiseptic performance against spore-forming bacteria.
- Gersan UV products offer a wide range of uses - solutions with compact and portable product designs.
- All of Gersan products have guaranteed, consistent, effective and traceable hygiene compatibility.
- Low Energy Consumption & maintenance and repair costs are almost zero and / or very low.

What is UVC or is UVC Safe?

Ultraviolet (UV) light is a component of the electromagnetic spectrum that falls in the region between visible light and X-Rays.

This invisible radiation includes the wavelength range of 100 nm to 400 nm. UV light can be further subdivided and categorized into four separate regions:

100 nm to 200 nm - Far UV or vacuum UV (these wavelengths only propagate in a vacuum)

200 nm to 280 nm - UVC – useful for disinfection and sensing

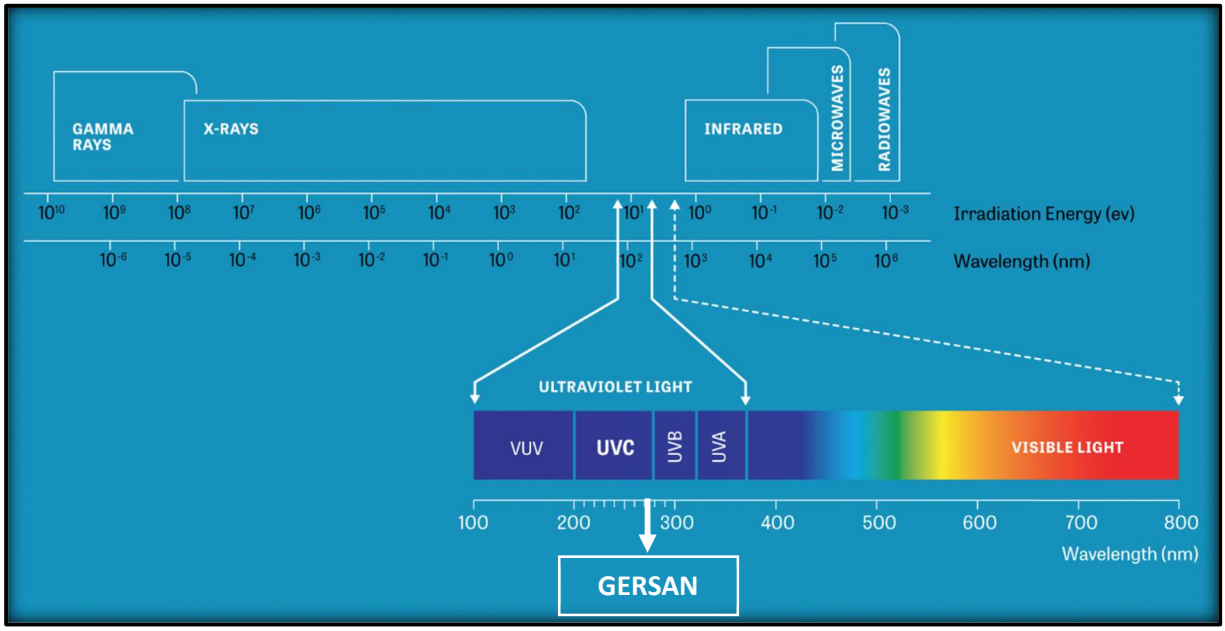
280 nm to 315 nm - UVB – useful for curing, tanning and medical applications

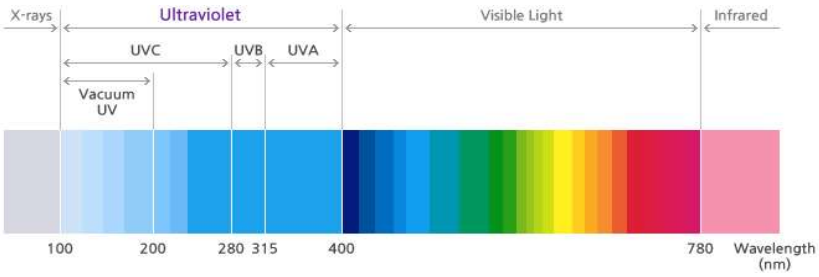
315 nm to 400 nm - UVA (or “near UV”) – useful for printing, curing, lithography, sensing and medical applications

Most natural UV light is generated by the sun with about ten percent of sunlight being UV and only about three to four percent penetrating the atmosphere to reach the ground. Of the UV radiation that reaches the earth, 95 percent is UVA and five percent is UVB.

No measurable UVC from the sun reaches the earth’s surface. Because of the spectral sensitivity of DNA, only the UVC region demonstrates significant germicidal properties.

The UV range of the electromagnetic radiation spectrum extends from 10 nm to 400 nm. Depending on the wavelength and time of exposure, UV radiation may cause harm to the eyes and skin.





UVC radiation refers to wavelengths shorter than 280 nm. These wavelengths are entirely absorbed by our atmosphere and no natural UVC radiation reaches the surface of the earth. These wavelengths are available to us through artificial sources, such as UVC LEDs or mercury lamps. The intensity from point sources like UVC LEDs falls off as 1 over distance squared, and once it gets past the scattering length, it falls off exponentially. This means that

1) the further away the UVC source from a human, the lesser dose he is exposed to, and

2) the absorption length of UVC radiation in human skin is extremely short so that almost no UVC radiation can reach the living cells in the skin; all the absorption occurs in the dead cell layers.

The scattering increases with decreased wavelength.

In rare instances of prolonged direct exposure to UVC light, temporary eye and skin damage has been exhibited, such as cornea injury (sometimes referred to as “welder’s eye”) although this generally heals after a couple of days. Therefore, safety recommendations with UVC LEDs include protecting skin (in particular open wounds) and, most importantly, the eyes from UVC radiation. The EU health agency’s safety guidelines on the use of UVC sources can be found here. In particular, the study concludes:

“In any case, UVC is strongly attenuated by chromophores in the upper epidermis (Young, 1997) and UVC-induced DNA damage in the dividing basal layer of human epidermis is not readily detected (Campbell et al, 1993; Chadwick et al, 1995) which may explain why the dose response curve for UVC erythema in human skin is very much less steep than for UVB (Diffey and Farr, 1991). It is unlikely that UVC from artificial sources presents an acute or long-term hazard to human skin. However, UVC is likely to cause acute photokeratitis… UVC exposure is unlikely to cause acute or long-term damage to the skin but can cause severe acute damage to the eye and should not be permitted at all from any tanning device.”

The same study found the minimum health and safety requirements regarding the exposure of workers to risks arising from artificial optical radiation (2006/25/EC) - albeit for all UV bands combined: “Exposure limit value for UV (180-400nm) is 30 J/m2 (= daily value of 8h)”

UVC Effect on Skin

Acute (short-term) effects include redness or ulceration of the skin. At high levels of exposure, these burns can be serious. For chronic (long-term) exposures, there is also a cumulative risk, which depends on the amount of exposure during your lifetime. The long-term risk for large cumulative exposure includes premature aging of the skin and skin cancer.

Personal Protective Equipment (PPE)

UV radiation is easily absorbed by clothing, plastic or glass. Once absorbed, UV radiation is no longer active. When working with open UV radiation during maintenance, service or other situations, personal protective equipment covering all exposed areas is recommended. When working around UVC devices, one should:

Use UV goggles and/or full-face shields.

Prescription glasses and normal safety glasses do not protect eyes from UV exposure, so ANSI Z87 rated eyeglasses with wrap around lens to protect the side exposure is recommended. Consult with ANSI Z87 manufacturers for proper UV exposure protection equipment.

Cover any exposed skin using lab coats, nitrile gloves or other lab attire.

UVC exposure can be reduced through product safety design considerations and controls. For example, safety switches wired in series allow UVC sources to be turned off without exposing workers to UV light. Or placing ON/OFF switches for UVC light sources separate from general room lighting in

locations only accessible by authorized persons. Switch locations should be locked or password protected to ensure that the UVC source is not accidentally turned on. Each UVC system should have

the option of a viewport so workers can view the lamp assembly without the possibility of over-exposure to UVC.

Proper installation, monitoring, education of maintenance personnel, signage and use of safety switches can help to avoid overexposure. The operating instructions and recommendations for proper use of any UV system should be kept for reference to reduce hazardous exposure. These should be clearly visible for the operators or maintenance personnel and include the temperature and relative humidity ranges specified by the system design to ensure safe operation. Maintenance should be performed according to manufacturer's instructions electric power should always be turned off to prevent accidental exposure. There are no standard guidelines for monitoring UV equipment, but there are commercial UV monitors that detect output or leakage.

If someone is directly exposed to UV beams, it is possible to experience health problems. Therefore, it is not possible to cause harm to human health due to the UV beams which is invisible to humans and emitted by the machinery and equipment that provides air and water disinfection. UV beam is only emitted during the operation of the machinery and equipment targeted to the point and field. Accordingly, there is no problem in using UV equipment – machines operating in an isolated and targeted manner in order to disinfect water and air 7/24 in places where people are present.

What is Virüs, Bacteria and Endospores

1 – Viruses

Definition.

Viruses are tiny, infectious parasites that, unlike bacteria, fungi and protozoa, require a host to replicate. Viruses are typically sensitive to environmental conditions and cannot survive for long on surfaces. However, viruses can be highly infectious, easily transmitted and, being the smallest of the pathogens species, very difficult to eliminate with filtration.

A bacteriophage is a species of virus that invades bacteria and reproduces inside. Sometimes called phages, these viruses can be responsible for making bacteria pathogenic as well as a vehicle to combat superbugs. The most widely recognized examples of phage-encoded virulence factors are exotoxins, which is the major factor of several bacterial pathogens, including cholera, diphtheria and botulism.

Scope of problem.

Viruses can quickly spread through contaminated water and airborne droplets. Each year millions of school aged children are afflicted with Influenza (the “flu”), Rhinovirus (a cold), streptococcal pharyngitis (strep throat) and respiratory syncytial virus (RSV), with airborne transmission being a primary vector. During the 2016–2017 flu season, influenza infections resulted in an estimated 30.9 million people getting sick, 14.5 million going to a health care provider, and an estimated 600,000 people being hospitalized.

Featured Virus: Norovirus.

Norovirus is an example of a highly contagious, small, non-enveloped virus transmitted through food, water and touching contaminated surfaces. In the U.S., it is the leading cause of illness and outbreaks from contaminated food. Norovirus can spread quickly in closed places like daycare centers, nursing homes, schools and cruise ships.

A person with norovirus infection can shed billions of norovirus particles but it only takes as few as 18 viral particles to infect another person. During outbreaks, norovirus can spread in several different ways. For example, a person who is infected by eating contaminated food in a restaurant can spread the virus to household members through direct contact or indirectly by touching objects and surfaces.

The pathogenicity of norovirus makes testing and analysis of disinfection performance difficult and challenging. Instead, scientists rely on surrogate bacteriophages such as MS2 and Qβ.

2 – Bacteria

Difinition.

Bacteria are single-cell micro-organisms that can be found virtually everywhere. Population growth and rapid urbanization strains environmental and infrastructure

systems. Drinking water contaminated with microbes such as E. coli cause gastrointestinal disease, which in turn leads to further food or water contamination. This creates a vicious circle where the disease can spread quickly through a population.

In large cities there is an escalating concern in airborne transmission. Tuberculosis (TB), while relatively uncommon in developed regions, is latent in 25 percent of the world's population with some 10 million people developing active TB each year and 1.7 million deaths from the infection.

Scope of problem.

Non-spore forming bacteria, while less challenging in terms of disinfection than their spore forming cousins, are of increasing concern because of the growing resistance to antibiotics. Health experts have warned that if antibiotics lose their effectiveness that many of today's key procedures (e.g. organ transplant, chemotherapy, joint replacement) could become dangerous to perform.

Featured Bacterium: Escherichia Coli.

Escherichia Coli (E. coli) is a bacterium present in very high numbers in human and animal feces. The presence of E. coli in water indicates recent fecal contamination of water supplies and may indicate the possible presence of other disease-causing pathogens.

For this reason, E. coli is an indicator organism or reference pathogen for the presence of pathogenic bacteria in water. Many systems are designed around achieving 3 log reductions or greater of E. coli with the expectation that if E. coli is controlled, other pathogenic bacteria is as well.

The EPA Standard for Microbiological Water Purifiers & the associated NSF standards for Class A UV microbiological treatment systems require a minimum 6 log reduction/inactivation of E. coli.

3 – Endospores.

Definition.

Endospores are non-reproductive structures that develop inside bacteria. Spore forming bacteria are tough. These species, which include Bacillus, Clostridioides and Clostridium, can surround themselves with durable coats of protein that allow them to survive in hostile environmental conditions. As spores, bacteria can remain dormant for years, protected from chemical and heat stresses.

Scope of problem.

In combating Clostridium difficile (C. diff) not only are strains of the bacteria becoming antibiotic resistant, the spores themselves are resistant to many disinfectant products. C. diff infections can create a frustrating and complex challenge for healthcare facilities – patients who are admitted for one problem and receive antibiotic treatment can, in turn, become a greater risk for infection by other pathogens they come in contact with. Today, approximately 80 percent of C. diff infections remain

healthcare-associated with the majority impacting patients in the expanding population of people over the age of 60.

Featured Endospore: Clostridium Difficile.

In healthcare settings, Clostridioides (Clostridium) difficile (C. diff), whose symptoms range from diarrhea to life-threatening inflammation of the colon has emerged as a significant threat. C. diff can be found on surfaces, devices, or material (e.g. commodes, bathing tubs, etc.) that becomes contaminated with feces. In its endospore form, C. diff can remain viable on surfaces for several weeks, even months. C. diff spores are transferred to patients mainly via the hands of healthcare personnel who have touched a contaminated surface or item.

Ensuring Complete Inactivation.

Generally, in bacteria, a number of different repair mechanisms have evolved to repair these UV-induced lesions. These mechanisms include direct reversal of the damage by a photolyase (photo reactivation), removing of the damaged base by a DNA glycosylase (base excision repair, BER), incision of the DNA adjacent to the damage by an endonuclease (UV-damage endonuclease, UVDE) or removal of a complete oligonucleotide containing the damage (nucleotide excision repair, NER). As a result, the strategy in UV disinfection has been to provide a sufficiently high dosage to ensure that nucleic acid is damaged beyond repair.