GIMAT Liquid Monitoring

Application News
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Covid-19 / Corona - More safety for customers, patients and employees with cents for disinfecting air

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The corona pandemic hit numerous countries in the first half of 2020 with high numbers of infections, numerous victims and devastating economic consequences. The highly contagious virus spreads through the air and, under suitable conditions, can persist as an aerosol for a long time. Badly ventilated interior rooms are the main sources of transmission with particularly high infection rates.
UV-C light kills viruses and bacteria. An UV-based air disinfection device eliminates infectious germs in the room air and increases safety for employees and customers. VIBA_EX, the modern air purifier from GIMAT, for room sizes up to 100 m² is now fully developed and affordable.

The Covid-19 disease, which began to spread in late 2019, has developed into a global pandemic within a few months.

Progress and symptoms of Covid-19

A disease with Covid-19 lasts on average two to six weeks. Typical consequences of a Covid-19 disease are difficult to describe. In fact, a range of possible symptoms was observed in the recorded cases of illness, which can occur to different degrees. Patients sick with Covid-19 often suffered from a cough, fever or common cold. Disorders of the sense of smell and taste were also recorded and, in rarer cases, numerous other symptoms, including shortness of breath and various types of pain.[1] The best known is probably the risk of severe pneumonia caused by Covid-19, which can also lead to death. However, the disease can also proceed without any symptoms.
Anyone who has survived Covid-19, in the best case after a mild course of the disease, might still be struck. A medical study shows that consequences for the heart are likely: 60% of a group of patients who had recently overcome Covid-19 disease, myocarditis was found, even though two thirds of those tested only had a light course of disease, which they could cure at

home. [2]

Pandemic containment

The states affected by Covid-19 responded with tough containment measures to combat its further spread. These measures, unexpectedly necessary, were felt as abrupt, drastic restrictions in economic life and everyday life for everyone. With the flattening of the first wave of infections, the situation eased, but normal business operations, as before the pandemic, cannot yet be spoken of in many areas.
At the height of the first corona wave, surgeries reported a sharp decline in the number of patients who request appointments or who then appear for their appointments.[3] Medical specialists reported a decline between 30% and 80%. The statutory health insurance associations fear that further health problems will follow if patients miss routine and preventive examinations due to Covid-19.
Other industries noticed a similar reluctance from their customers. A survey of members of fitness studios in May 2020 found that two-thirds are reluctant to return to the gym and plan to deal with hygiene measures.[4]

Hygiene as a new challenge

It can be deduced from this that a considerable part of the population has apparently taken the hygiene rules, which are intended to protect against Covid-19 infection, to heart. For businesses this means a new challenge: guests or customers/ patients are deterred by the fear of being infected with pathogenic germs. The not always pleasant or practicable hygiene rules such as maintaining social distancing, disinfecting or wearing mouth and nose protection are well known. In the meantime, however, the active disinfection of room air in rooms of all sizes is possible and affordable.
Hereinafter, we will first turn towards to pathogenic germs. After that an overview of the two established systems for disinfecting air will follow.

Viruses

Viruses cause numerous diseases in humans, including both common and severe diseases such as influenza, herpes, measles, rabies or Ebola.[5] Typical means of transmission are droplet infection or contact infection.[6] Viruses have a size of 18-350 nm. Aerosols with viruses can therefore fall into the demanding area for HEPA filters but can also be held back to a large extent in case of a sufficient filter class as well as a professional installation.[7]

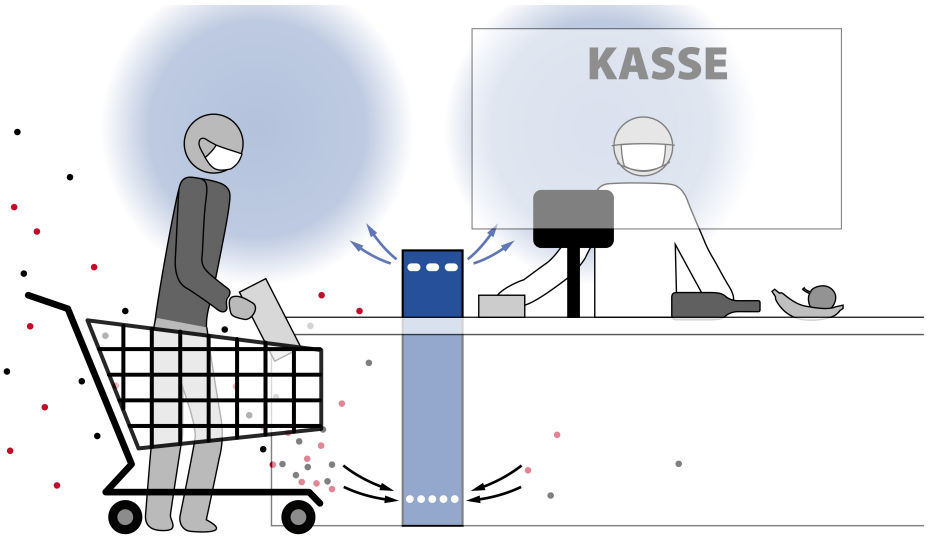
Bacteria

Bacteria are single-celled organisms that can be found almost everywhere and under the most varied environmental conditions.[8] They play different roles for humans. The skin e. g. is usually covered with harmless bacteria.
The pathogenic bacteria include triggers of tuberculosis, cholera and tetanus.[5] Many bacteria are 1–10 µm in size.

Infection Paths

The droplet infection is an important disease transmission for numerous airborne pathogens. Since Covid-19 this has also been well-known by the public. The significant, germ-bearing droplets arise when coughing or sneezing. Large droplets, which are typical for sneezing or coughing, land on the floor within a second.
The disease transmission as aerosol, i. e. with even smaller droplets, is less common. Such microdroplets arise when speaking and can be infectious for hours.[9] They are so small and light that they can stay in the air for a long time.
The well-known virologist Christian Drosten, Charité Berlin, Germany, estimated in May 2020 that the aerosol disease transmission is about as important as the droplet infection for the currently raging corona virus.[10]
Infectious microdroplets can travel a long way from the person who expelled them, under suitable conditions. The room geometry and the activity of the ventilation system have an influence. In supermarkets, for example, such aerosols can even overcome the shelf walls in the adjacent aisle, according to current research results from the Finnish Aalto University.[11]
South Korea was one of the first countries, after China, to have larger numbers of Covid-19 infected people. The spread of the virus has been thoroughly investigated by the

Figure 1: Typical application of the VIBA_EX



Center for Disease Control there. Numerous employees in a call center in Seoul were infected in March 2020.[12] Of 216 employees on the 11th floor, 94 (43.5%) became infected. Striking was an accumulation on one side of the building, with most of the infected people sitting close together. In all other floors there were only 3 infections during this outbreak.
These and similar studies suggest that prolonged and close contact with infected people in closed rooms carries a high risk of infection.

HEPA Filter

Two systems for removing germs have now proven themselves in many applications: the removal of germs with filters or treatment with UV light to render them harmless.
The term HEPA stands for highly efficient particle filters for air. The development of HEPA filters began at the time of the Second World War, when protection against biological and chemical warfare agents or radioactive particles was required.[13] Later, in civil use, HEPA filters were ultimately used in numerous medical and various sensitive industrial applications, e. g. Microelectronics and Pharmacy. Particle sizes of approx. 0.1-0.3 µm are the most difficult to hold back for HEPA filters. HEPA filters are divided into different classes; H14, for example, holds back over 99.995% of particles in this difficult range of sizes. The retention capacity is better for both particle sizes above and below this range. The filter material must be replaced regularly, the interval depends on the load. A professional installation of HEPA filter systems is important, because problems such as leaks affect the filter performance.

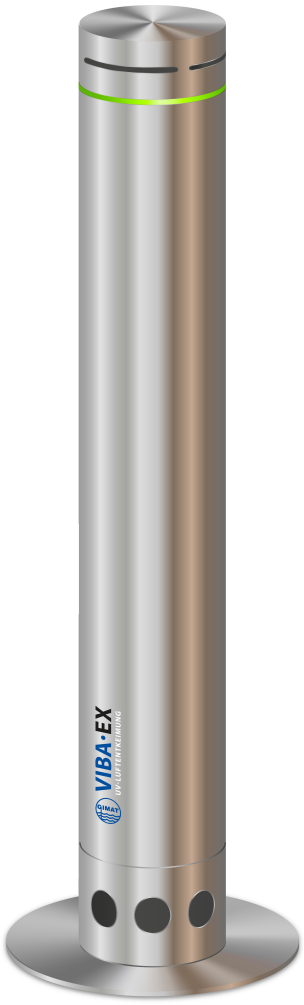
Disinfection with UV light

Before filling, the sterilization of food packaging, such as yoghurt pots, by radiation with UV light is now an established technology. The process greatly reduces the germ load on the packaging and thus extends the storage life of food. The required radiation time, typically 2-4 seconds are sufficient in this application, depends on the type of germs - bacteria, viruses or fungi – as well as the intensity of the UV lamp.[14] Due to deterioration of performance over time the UV lamp in such devices must be replaced regularly. Modern UV lamps have an endurance of one year.

The little UV dictionary

UV light is high-energy light outside the range of being visible to humans. UV radiation can damage the genetic material (DNA).[15] The UV range is divided even more finely into the components UV-A, UV-B and UV-C based on the wavelength and energy of the UV light. The sun is a natural source of UV radiation in the entire UV range. UV-A connects directly to the visible range of light with wavelengths of 400–315 nm; its DNA-damaging effect is less than that of the other parts.
This is followed by UV-B with 315-280 nm. The UV-B component of sunlight is partly blocked by the ozone layer in the atmosphere.
The most energetic part is UV-C with 280-100 nm. The UV-C part of sunlight is completely absorbed by the earth's atmosphere. Due to its strong DNA-damaging effect, UV-C light can render viruses and bacteria harmless. [16, 17] UV-C lamps can be used for UV disinfection.

Figure 2: VIBA_EX



Measures for room air

The risk of aerosol transmission can be countered by reducing the virus load in the room air. According to virologists, regular ventilation can be more important than washing hands or disinfecting in many everyday situations.[10] A current study shows that in a well-ventilated room, the amount of aerosol in the room air is halved in less than a minute.[9] In the unventilated test room, however, this was not the case, the aerosol stayed ten times as long.
However, ventilation is not possible or practicable in all locations. Noise from the surroundings, infiltration, uncomfortable outside temperatures in winter or summer or even completely missing windows can be opposed to ventilation.
In such cases the UV air disinfection device VIBA_EX is an effective and sensible alternative.
VIBA_EX is self-priming. Deep suction holes even capture aerosols floating on the ground.
A sophisticated construction is the reason for the convincing disinfection performance.
Only a sufficient residence time of the with germs contaminated air in the UV light can ensure that it is almost completely destroyed. This is ensured by the generously dimensioned volume in the VIBA_EX, which is achieved through the pipe length of 130 cm with a diameter of 20 cm.
Our own surveys on the topic

showed that 72% of those questioned would welcome a longer or much longer time for the sterilization, because it further improves their subjective feeling of security.
The VIBA_EX relies on a long dwell time and thus safe deactivation of the germs.
Competing products, on the other hand, are sometimes much smaller, e. g. less than ½ m long and noticeably thinner. The smaller volume of such devices forces either a low throughput or a very short dwell time of sometimes less than a second.
The air flow is directed past a UV-C lamp, which is located in a reflective stainless-steel tube. The UV light is reflected several times on the shiny metal surface inside the pipe. As a result, the UV light is highly efficiently used - high output with just one UV lamp. The principle is comparable to the situation in high mountains. Sunlight, reflected from ice and snow surfaces, can be intense enough there to cause eye damage in the form of snow blindness.
The UV lamp in the VIBA_EX does not generate any harmful ozone.
Special coatings from the world market leader are used in the VIBA_EX. These coatings, which are also used in space technology, hold back 99.995% of UV rays. In contrast to some other products, this provides perfect protection for people and pets who can stay in the room during operation.
The air to be cleaned flows through the VIBA_EX from bottom to top. The internal structure is strictly based on detailed scientific studies on air flow.
The vortex flow technology specially developed by GIMAT leads to spiral air circulation inside the VIBA_EX (Figure 3). This guarantees an average dwell time in the air of approx. 14 seconds. The dose of UV radiation emitted during this dwell time reliably deactivates over 99.9% of bacteria and viruses.
The VIBA_EX disinfection device is designed in a way that the air flow does not have an unpleasant effect on people. In a study with 17 test persons, no one noticed a draft within a distance of 50 cm from the VIBA_EX.
VIBA_EX has been developed for continuous operation in 24/7 use. The average concentration of germs is minimized. The throughput is approx. 70 m³/h, i. e. the air in a typical waiting room in a surgery is sterilized several times a day.
Thus used, the max. operating time of the UV lamp is up to 10,000 hours, i.e. about a year. After this period, the lamp must be replaced.
The daily power consumption in 24 h continuous operation is around 1kWh.

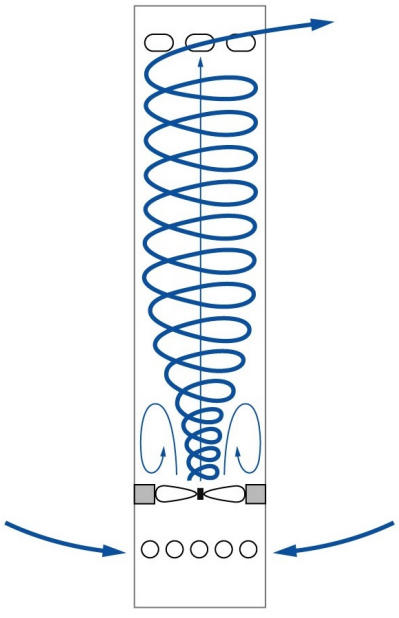
Table 1: Example calculation for VIBA_EX in an office (rounded)

Item	Required (5 years)	Price/unit		Amount
purchase				1550 €
replacement UV lamps	3 pcs	×80 €	=	240 €
energy costs	5×368 kWh	×0,30 €	=	550 €
total costs 5 years				2340 €

Effective Uptime				
⌀ per day	⌀ per year	in 5 years		
10 h	×220 days	×5	=	11000 h

Costs per hour of operation	2340 €/11000 h	=	0,21 €/h

Figure 3: Turbulent flow in the VIBA_EX



Cost-Benefit Calculation

A model calculation using the example of an open-plan office can be seen in Table 1.
An economic efficiency calculation assumes an expected useful life of the VIBA_EX of 5 years. The regular period in which the office is used is 10 hours on working days. In simplified terms, it is assumed that there are people in the office all year round. With 220 working days, there are arithmetically 2200 hours per year in which the office is used by employees.
In addition to the acquisition costs for a VIBA_EX, its operating costs must also be considered in a cost-benefit decision, whereby it is assumed that the purchaser is entitled to a deduction of input tax. All calculations were therefore carried out without taking VAT into account.
Two UV-C lamps are included in the scope of delivery, so that 3 additional lamps are required within a 5-year period of use. The device is designed for 24/7 operation. When calculating the electricity costs, expected future price increases were already taken as a basis. The acquisition and operating costs are shown in Table 1.
If all costs are allocated to the individual hour in which the office is effectively used, additional costs of only 21 cents per hour arise.
Some doctors and retailers report

positive feedback from customers and patients after a short time. Due to the improved feeling of security, the patient or customer frequency has increased with some applications of the VIBA_EX, which leads to additional income.

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