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Mini Review

Health care functions of ozone sterilizer

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Abstract

People's Daily life and physical health are often plagued by viruses and bacteria. The novel coronavirus epidemic several years ago has seriously affected the global economy and social life. In addition to vaccination, ecologically safe and long-term and effective disinfection methods are very necessary. Ozone is an efficient and broad-spectrum bactericidal disinfectant, and the trace level of ozone in the atmosphere can make many viruses and bacteria lose their biochemical activity and infectivity. Nature produces trace amounts of ozone in the air through lightning to achieve the purpose of purifying the ecological environment. The product of ozone decomposition is oxygen, without secondary pollution. Ozone sterilizer has been widely used in epidemic prevention and control in intensive breeding farms and has achieved remarkable effects. If the concentration and action time can be accurately controlled, then ozone can effectively eliminate pathogens without harming normal cells in the human body. Therefore, the use of mini household ozone disinfectors for personal epidemic prevention and health care is a topic worth serious research. Shanghai Finerule Company has done a lot of tentative work in this respect and has achieved some good results.

Introduction

Ozone O_3 is an allotrope of oxygen O_2, which is an unstable and light blue gas with a fishy smell. At room temperature, the half-life of ozone in the air is about 3 hours, which depends greatly on factors such as humidity and ozone concentration. The half-life of ozone in 20 °C water is only 16 ~ 25 minutes. As a chemically active molecule, ozone has an oxidation potential of 2.07V, which is higher than that of hydrogen peroxide, chlorine dioxide, chlorine gas, and permanganate [1]. In addition, ozone can also be converted in water to form a more active hydroxyl radical (-OH, oxidation potential of 2.8V), which has an indirect oxidation effect [2]. Ozone is a broad spectrum of high-efficiency disinfectants, that react very quickly and can inactivate various pathogens, such as bacteria, fungi, and viruses [3,4]. Ozone attacks proteins and lipids in the viral spiking synapses and envelope, disrupting viral integrity and thus inactivating the virus. Ozone chemically reacts with the bacterial cell wall and the proteins in it, rapidly entering the cell wall, and oxidizing intracellular enzymes, RNA, or DNA, thereby killing the pathogens [5,6].

Now the ozone production technology and process have become very mature, and the industrial method of ozone production is mainly the corona discharge method. Ozone generator produces ozone with dry air or oxygen as raw material for the disinfection and purification of air, water, and articles [7]. Ozone has been widely used in the disinfection of drinking water, air, and object surfaces. For different action media, not only ozone gas can be used for sterilization, but ozone water can also be used for disinfection. Ozone as a disinfectant can kill a wide range of pathogens and pathogenic microorganisms, including bacteria (such as Escherichia coli, Staphylococcus aureus, etc.), various types of cellular spores, fungi, and viruses (such as hepatitis viruses, influenza viruses, norovirus, and coronaviruses, etc.). The mechanism of ozone disinfection includes a combination of chemical, physical, and biological aspects.

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Compared with other disinfection methods, ozone disinfection has no harmful residue and secondary pollution, the air disinfection concentration distribution is uniform and has no dead end and the use is convenient and fast. Ozone has been widely used in indoor air disinfection, tap water disinfection, farm epidemic prevention, sewage depth treatment, and other occasions [7]. Ozone is used as a disinfectant, is more effective, shorter reaction time, and has lower microbial regeneration than chlorine. In addition, residual ozone gas can be decomposed into oxygen in a short time, so secondary environmental problems are greatly reduced compared with chlorine disinfection technology.

Epidemic prevention and health care effects of ozone

For the disinfection of air in ordinary places, the ozone concentration is 1 ~ 2 mg/m^3, the relative humidity is ≥ 60%, lasting 30 ~ 60 min, and the inactivation ratio of various bacteria can reach more than 99% [6,7]. Ozone can simultaneously degrade sulfur dioxide, nitrogen oxide, volatile phenol, and formaldehyde in indoor air pollutants degradation rate of 41%. After 30 min of ozone at a concentration of 0.3 mg/m^3, the titer of hepatitis B surface antigen (HBsAg) decreased from l: 256 to 1:64. After disinfection with an ozone concentration of 13.6 mg/m^3 for 30 min, the inactivation rate of HBsAg could reach more than 99.99%, and the fire extinguishing rate of Hepatitis a Virus Antigen (HAAg) reached 100%. The speed of ozone sterilization is 300 ~ 600 times faster than that of chlorine agents.

There are also some studies on the use of ozone in COVID-19. Related studies show that ozone molecules can be directly used in clinical, the main mechanism is the ozone molecule can directly attack the SARS-CoV-2 virus surface spike protein, not only directly destroying the spike protein structure, but also inhibiting the combination of spike protein and human lung cell angiotensin conversion enzyme 2, which can greatly reduce the SARS-CoV-2 virus infectious and pathogenic [8-10]. It reveals that ozone attacks the spiking synaptic and envelope proteins of the novel coronavirus, destroying the integrity of the virus and thus inhibiting viral infection [8]. Ozone can oxidize and inactivate the virus while stimulating the immune system in patients' cells and body fluids, which is useful in the early COVID-19 infection phase [10]. Ozone can improve gas exchange and reduce inflammation, as well as hypoxemia and multiple organ failure periods. The above evidence directly proves the good clinical application prospect of ozone in blocking the spread of the SARS-CoV-2 virus [11]. Analysis shows that the combined drug therapy can be enhanced by intravenous injection of ozone water as an adjuvant treatment method [12]. There is more research on using ozone to fight against COVID-19. For more messages on this issue, refer to the following articles and their references [13-18].

Trauma repair is a relatively complex biological process, with multiple inflammatory cells and cytokines existing in this biological process. Ozone can promote the division of fibrotic cells, effectively promote wound healing, and repair and rebuild the barrier function of the skin. Skin is an important barrier for the body to prevent bacteria and other microorganisms from invasion, and can effectively resist the invasion of bacteria. However, if the skin mucosa is damaged, the wound surface is infected, adversely affecting the healing of the wound. Studies have shown that in patients during trauma, inflammatory damage is dominant [19]. In the process of treating infectious wounds, it is difficult to achieve the ideal treatment effect by using conventional topical drugs, such as chemical disinfectants, antibiotics, heavy metal salts, and other drugs. The proportion of patients with adverse reactions is high, and the microorganisms of the body can easily develop resistance to the drug [20]. The grade A healing rate of the patients with ozone disinfection was 83%, and the healing effect was significantly higher than that of the conventional disinfection method. Ozone disinfection is conducive to the growth of new epithelial tissue on the wound surface, and can effectively eliminate the inflammation of the wound surface to achieve the purpose of anti-inflammatory repair. In addition, ozone disinfection technology also has the advantage of quick effect, the patient's wound healing in about 4 ~ 5 days, and the wound healing time is significantly shorter than the conventional disinfection methods.

The authors' experience shows that, if you have just caught a cold and start sneezing and shedding tears, breathing 10 ~ 20 ppm (vol) ozone air for a minute will heal quickly in most cases. Because novel coronavirus is highly sensitive to ozone, this method is also suitable against COVID-19. Within 4 ~ 5 hours of exposure to novel coronavirus, the virus still stays on the surface layer of the respiratory mucosa, breathing 10 ~ 20 ppm (vol) ozone air for one minute, and gargling with ozone water, which can avoid infection. For pharyngitis and Helicobacter pylori, drinking ozone water or swallowing 4 mouths high concentration ozone air has an obvious effect. For new trauma wounds, using ozone with a concentration of more than 500 (vol) to purge the wound for 1 ~ 2 minutes, can effectively prevent wound infection and accelerate wound healing. How to use a mini ozone sterilizer to prevent influenza and novel coronavirus is shown in Figure 1.

During the COVID-19 outbreak, the first author insisted on ozone disinfection when encountering dangerous environments and did not infect the novel coronavirus until July 2023. In July 2023, the epidemic slowed down, so he did not carry an ozone sterilizer on a business trip. After returning home, he started coughing, dizziness, and body pain, so he received ozone air treatment. Through the antigen detection of novel coronavirus, the results were ambiguous. After 4 days, the symptoms were resolved. After a nucleic acid test, it was found that the author was infected with COVID-19. However, the author did not have a high fever, did not lose taste and smell, and did not use any antibiotics and antipyretics. Therefore, as long as the novel coronavirus does not heavily multiply and spread in the body, ozone therapy is very effective.

There are also some studies on the toxicity and side effects of ozone in humans. There are some statistics on the effects of environmental long-term mild ozone pollution on the inflammation of the respiratory system and ischemic heart disease [21-23]. Clinical experiments using ozone as an

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Figure 1: Operation of household ozone sterilizer to prevent influenza and COVID-19.

adjunctive therapy for COVID-19 show that ozone has no definite toxicity and side effects on patients [24,25]. Experience shows that ozone has a promoting effect on wound healing [19,20]. Compared with other antibiotics, ozone has less toxicity and side effects and can be better controlled. Therefore, under the reasonable control of concentration and action time, ozone can ensure the complete inactivation of pathogens without harming the normal cells of the human body.

Conclusion

Ozone is not only a broad spectrum of highly efficient disinfectants but also a green environmental protection product. By appropriate control of ozone concentration and action time, ozone will have a high inactivated rate for most infectious disease viruses and bacteria, and will not produce side effects on the human body. Using a mini household ozone disinfector for the prevention of influenza and inhibiting skin disease, the authors have a good effect on prevention and control. Ozone disinfection is of great practical significance to the prevention and control of epidemic diseases. In the future, in the clinical research of infectious diseases, more attention should be paid to the powerful epidemic prevention and healthcare functions of household ozone sterilizers.

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