CHINA INTEGRATED CITY INDEX
China City Comprehensive Development Index | China Castle City

POSTED BY: WPMASTER

Measures against the new coronavirus using ozone

Ozone: a powerful weapon to combat COVID-19 outbreak

Bokushi Shu / Tokyo Keizai University Professor
ZHOU Muzhi / Professor of Tokyo Keizai University

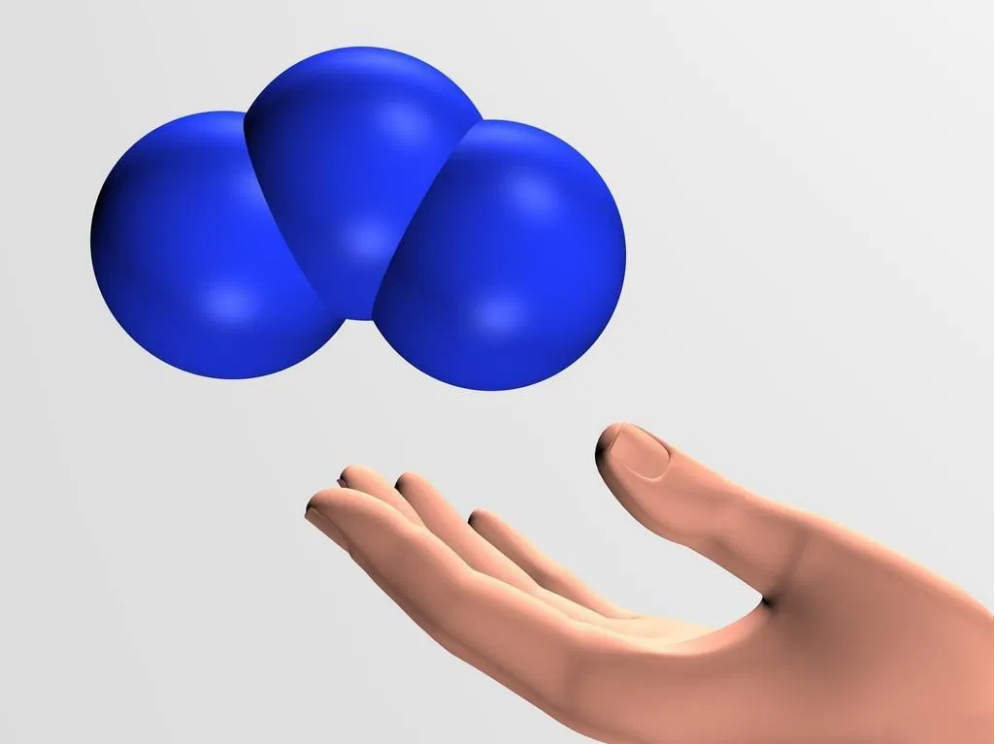
From December 2019, an epidemic of an infectious disease similar to Severe Acute Respiratory Syndrome (SARS) has been reported in the south of China. In Hubei Province, on January 23, 2020, three cities including Wuhan, the provincial capital, were locked down (city blockade) to contain the infectious disease. Since then, almost the entire area of Hubei Province has been locked down, and many cities have been blocked throughout China. The State Council of the People's Republic of China called the infection "New Coronavirus Pneumonia (NCP)" at a press conference on February 8. On February 11, WHO named the infection COVID-19. ..

Since mid-January, the author has been engaged in ozone research, which is a countermeasure against the new coronavirus. On February 18th, a paper on the theme of "this individual" sacred treasure "Noh virus new coronary disease poison" (hereinafter abbreviated as "February weekly paper") was published [1], Unraveled the mystery of ozone, explored the mechanism of convergence of epidemics, and proposed the use of ozone as a countermeasure against the new coronavirus. The announcement of the "February Weekly Treatise" on China Internet Information Center, a major Chinese internet media, was quickly reprinted in many media and helped to use ozone in the countermeasures against the new

coronavirus. The announcement of the "February Weekly Paper" was three weeks earlier than the WHO Pandemic Declaration on March 11.

On February 26, the English version of the "February Weekly Treatise" was announced in the English version of the China Internet Information Center (China.org.cn) under the theme of "Ozone: a powerful weapon to combat COVID-19 outbreak" [2] . And the Japanese version was also published on March 19th in the Chinese network Japanese version (Chinanet) entitled "Eradication of the New Corona Virus with Ozone Power" [3] .

Due to the nature of the media, the "February Weekly Treatise" had restrictions such as annotations, so in this paper, we will add annotations based on this "February Weekly Paper", update the latest information, and further enhance the hypothesis of the paper. Delve into and verify.



1. 1. Guardian deity of life on earth

Since the new coronavirus is explosively generated in Wuhan, the author of China's far-reaching Science & Technology Group has been a series of discussions about (BROAD Group) president, using Zhang thermocline Mr. and ozone sterilization [4] . Mr. Zhang Yi is one of the pioneers who advocates sterilization and disinfection using ozone. However, the public response has not been good so far. The author also strongly felt the caution of people

about ozone through interviews with domestic and foreign experts on ozone use and surveys of related materials. In order to eliminate misunderstandings about ozone and to overcome the situation by actively using ozone in the emergency situation of corona disaster, we tried to comprehensively sort out the extremely difficult-to-understand characteristics of ozone.

The lowest layer of the Earth's atmosphere, about 0 to 10 km, is called the troposphere, and the relationship between temperature and altitude is the upper and lower heat. At the top of the troposphere is the stratosphere of about 10 to 50 km. In the stratosphere, the relationship between temperature and altitude is opposite to that in the troposphere, and it is hot and cold. The ozone layer with a concentration of about 10 to 20 ppm is in this stratosphere.

The ozone layer is an irreplaceable existence for life on earth. The ozone layer absorbs the part of ultraviolet rays that harms living things on the earth [5] . Therefore, the ozone layer suppresses the destruction of genes in living cells by harmful ultraviolet rays, giving life on earth a survival condition.

The time when the concentration of the ozone layer reached the current level coincides with the time when life on Earth landed from the sea . [6] In other words, when the ozone layer was still lean, life had to hide in the ocean to avoid harmful UV rays. After waiting for the concentration of the ozone layer to improve, I was finally able to land.

Without the protection of the ozone layer, even a single microorganism could not exist on Earth. Of course, the prosperity of today's rich life could not have been possible.

However, chlorofluorocarbons and volatile organic compounds (VOCs) emitted in large quantities by human industrial activities destroy the ozone layer [7] , weaken the human immune system, and cause skin cancer and cataracts. It caused damage that increased the incidence . [8] Along with global warming, the ozone hole is now a global environmental problem [9] . At the same time, the problem of ozone depletion also triggered ozone to enter the public's horizons.

The ozone layer is called the "Earth Guardian" because of its protective properties.

Ozone is composed of three oxygen atoms, is an allotrope of oxygen, and has a special odor [10] . Ozone is mainly produced by the sun's ultraviolet rays splitting oxygen molecules into two oxygen atoms, which further combine with oxygen.

Ozone produced by ultraviolet rays becomes a high-concentration ozone layer and acts as a natural barrier to protect the organisms on the earth from the harmful ultraviolet rays in sunlight and bring about the prosperity of life on earth. It's a really interesting relationship.

2. 2. **Good Ozone on the heavens, Bad Ozone on the ground ?**

Ozone is not only in the high sky stratosphere, but also around us as the troposphere. Oxygen molecules are abundant at low altitudes and few at high altitudes. On the other hand, oxygen atoms are few in the low altitude and many in the high altitude. Therefore, an ozone layer is formed at a high concentration in the stratosphere where both oxygen molecules and oxygen atoms are present. Contrary to this, the ozone concentration on the ground and above the ozone layer is low. In other words, the ozone concentration in the atmosphere is higher than about 10 km from the ground, and is the maximum in the ozone layer in the stratosphere. Further above it, the ozone concentration drops sharply again.

The ozone concentration in the convection zone is generally 0.02 to 0.1 ppm. This natural ozone concentration is harmless to large organisms, including humans. However, high concentrations of ozone can cause discomfort to humans and can irritate mucosal tissues such as the eyes and respiratory tract. Therefore, the US Food and Drug Administration (FDA) has set the maximum ozone concentration in the indoor environmental standard at 0.05 ppm [11] . The Japan Society for Occupational Health defines the permissible ozone concentration of the industrial environmental standard as 0.1 ppm [12] . The Ministry of Health of China (Ministry of Health) also stipulates a safe ozone concentration of 0.1 ppm [13] .

As mentioned above, there was a sense of caution against high-concentration ozone. In addition, it was photochemical smog pollution that made ozone notorious. Photochemical smog stimulates the mucosal tissues of the eyes and respiratory organs, causing health hazards such as eye pain, headache, cough, and asthma. It also suppresses plant growth and reduces crop production. It is also a cause of acid rain.

Primary pollutants and secondary pollutants are mixed in photochemical smog. Primary pollutants include nitrogen oxides (NOx) and volatile organic compounds (VOCs). When the primary pollutants are irradiated with ultraviolet rays, ozone, which has been made into a "secondary pollutant", is generated. Since the ozone component of photochemical smog reaches 80 to 90%, people tend to think that photochemical smog pollution is equal to ozone pollution.

Since the Industrial Revolution, large amounts of NOx emissions have increased ozone in the troposphere . [14] Over the last 100 years, the total amount of ozone in the troposphere has quadrupled . [15] Especially in recent years, with the rapid industrialization and urbanization in China and other East Asian countries, the emission of photochemical smog-producing substances such as NO_x has increased sharply, accelerating the increasing trend of ozone in the troposphere.

Although the amount of ozone in the troposphere is only one tenth of that in the stratosphere, it is the third global warming gas after carbon dioxide (CO_2) and methane (CH_4). The image of ozone was further deteriorated by becoming a warming gas.

For these various reasons, the public is widely aware that ozone in the troposphere is a harmful pollutant to living organisms. Therefore, ozone is also called "Good Ozone on the heavens, Bad Ozone on the ground". Monitoring the global cross-border pollution of tropospheric ozone has become an important issue in Japan.

What I would like to clarify in this paper is that the ozone concentration of photochemical smog is not the normal concentration in the natural world of the troposphere, but the unnatural high concentration caused by the pollution emission of human activities. Furthermore, ozone in photochemical smog contains many harmful substances such as NO_x and VOC. This is also quite different from the clear ozone in nature.

Ozone concentration varies depending on the season and region, [16] but in general, ozone in the natural troposphere does not harm the human body. Natural ozone is not only harmless, but rather beneficial. For example, in the high-pressure discharge of lightning, oxygen in the air is split to produce ozone. High concentrations of ozone purify the air, which often makes the air cleaner after lightning. In addition, the air is even cleaner because the ozone concentration is high on the sunny coasts and forests. We must distinguish the difference between ozone in nature and photochemical smog.

Ozone in the troposphere is also the guardian deity of human survival. However, we have long lacked research and awareness of its benefits.

Although the ozone concentration in the tropospheric nature is harmless to large organisms, it is a super killer for microorganisms. Ozone, which has strong oxidizing power, has suppressed the growth of microorganisms in the natural world and has maintained the global ecological balance. However, until now, the role of ozone, which suppresses microorganisms, has not been sufficiently emphasized in the life form of the earth . [17]

One of the reasons is that it has been generally considered that low-concentration ozone has little bactericidal action. However, in reality, it has been confirmed that even extremely low concentrations of ozone have sufficient bactericidal and disinfecting power over a certain exposure time [18] .

Based on the recognition of the bactericidal and disinfecting effect of low-concentration ozone, the author hypothesizes that "low-concentration ozone in nature has prevented the excessive growth and diffusion of microorganisms such as bacteria and viruses on the earth" (hereinafter "Hypothesis 1"). (Abbreviated as).

Ozone also decomposes harmful organic matter in nature. Furthermore, ozone is also considered to be a signal that informs animals and plants of seasonal changes.

From the perspective of this important role of ozone, without ozone in the stratosphere and ozone in the troposphere, the earth would not even be able to survive.

In fact, ozone is "Good Ozone on the heavens, Good Ozone on the ground". It is the polluted waste produced by humankind that has turned ozone on the ground into a "Bad Ozone."

3. 3. "God's Hand" Hypothesis: Does Ozone Eliminate the Plague?

From the winter of 2002 to the spring of 2003, the SARS pandemic caused a major social panic. However, SARS disappeared from May to June 2003.

In addition to SARS, most droplet-borne viruses such as influenza explode in the fall and winter and disappear in the spring and summer. A clear fate pattern can be seen for each season. It is as if the invisible "hand of God" is driving out these poisons.

Many researchers around the world have tracked the correlation between viruses and temperature, or between viruses and humidity . [19]However, these studies have not yet clearly explained the relationship between viruses and temperature changes. Taking influenza as an example, it is generally considered that the virus remains active for a relatively long time in a low temperature and low humidity environment, and its activity is suppressed as the temperature and humidity rise. However, in experiments, it was confirmed that increasing the

humidity increased the degree of influenza virus extinction [20] . The range of temperature changes in nature had little effect on the influenza virus. In fact, the influenza virus is rather prevalent year-round, despite the highest temperatures near the equator . [21]

Based on the above "Hypothesis 1" that "low-concentration ozone in the natural world has prevented the excessive growth and diffusion of microorganisms such as bacteria and viruses on the earth", the author further wrote "Oxidizing power" in the "February weekly paper". It is hypothesized that ozone with virus is the true "hand of God" (hereinafter abbreviated as "hypothesis 2").

Ozone concentration has the property of changing with the seasons. Moreover, autumn and winter are low, and spring and summer are high. According to the ozone observation information of the Japan Meteorological Agency, the total amount of ozone [22] peaks in order from north to south in Sapporo, Tsukuba, Kagoshima, and Naha between February and May. The further north you go, the sooner the peak season will come. The peak is late in the south . [23]

The concentration of ozone varies from region to region. According to the observation information of the same Japan Meteorological Agency, the concentration at the peak of total ozone is higher as it goes north. On the contrary, the concentration is low in the south. The distribution of total ozone is clearly changing due to changes in latitude. The amount of ozone is the lowest near the equator, the highest in the mid- and high-latitude regions in both the north and south hemispheres, and the highest in the northern region near 60 ° latitude. In addition, the amount of ozone is higher in the northern hemisphere than in the southern hemisphere at mid-latitudes, especially over Japan [24] .

Originally, the stronger the ultraviolet rays, the faster the decomposition speed of oxygen molecules. Sun irradiation is maximum near the equator, and ozone should be the easiest to produce. However, there are many factors that bring about changes in ozone concentration, and the mechanism is extremely complicated. The stronger the ultraviolet rays, the easier it is to make ozone, and at the same time, the decomposition of ozone itself progresses. The decomposition speed of ozone is also related to temperature. The higher the temperature, the faster the decomposition speed . [25] Moreover, global atmospheric circulation cannot be ignored. Ozone produced in the area may be transported to other areas.

Most of the tropospheric ozone comes from the stratospheric ozone layer. At the same time, the amount of ozone produced by the photosynthesis of plants, the amount of ozone produced by lightning, the amount of NO_x and VOC emitted by human industrial activities ,

and the destruction of ozone by volcanic eruptions also affect the ozone concentration in the troposphere.

In short, the ozone concentration, which is influenced by the strange aggregate discreteness of oxygen molecules and atoms, has a low rhythm in autumn and winter and a high rhythm in spring and summer. Also, the higher the temperature, the faster the ozone decomposition rate. Humidity is also important, and humidity increases the power to inactivate the ozone virus. In dry conditions, ozone's viral inactivating power drops dramatically . [26]

Therefore, the author boldly made "Ozone is the true" hand of God "" and "Hypothesis 2". In other words, as the season warms from winter, the ozone concentration increases and the humidity of the air increases, and at the same time, ozone becomes the "hand of God" and eliminates the plague.

Further rigorously explaining this hypothesis, the main force that suppresses the virus is ozone, which increases with seasonal changes, and the rising temperature and humidity further increase its power. Ozone, temperature, and humidity combine to drive out a disease called a virus. Of course, ultraviolet rays are also a major killer of microorganisms and are an important factor in killing bacterial toxins outdoors.

When will the pandemic caused by the outbreak of the new coronavirus end? This is now the greatest concern in the world. Reconstruction of economic activity and relaxation of social tensions depend on this. If "Hypothesis 2" is established, the new coronavirus, like SARS and influenza, will disappear due to the increase in ozone concentration due to seasonal changes, and the "February Weekly Paper" made wishful thinking.

But even after the summer, the new coronavirus still afflicts us. This is probably related to the fact that the new coronavirus spread globally before the ozone concentration increased compared to SARS. However, in fact, in the situation of China and Japan, the violence of the new coronavirus has declined considerably since the beginning of summer. There is no doubt that the rise in ozone concentration in nature has played a role.

In the February paper, he called on scholars and experts to verify and criticize the above hypothesis from various angles, saying that the bold hypothesis requires precise proof.

4. To use ozone in manned space

Ozone is not only a eradication of pests in the natural world, but since modern times, it has been widely used in fields such as disinfection, sterilization, deodorization, detoxification, and bleaching by taking advantage of its strong oxidizing power to humankind.

Ozone should also be used in this global battle against the coronavirus. Moreover, ozone has the following three characteristics.

(1) Filling without blind spots: Ozone produced by ozone generators fills the room and reaches all of the space. There is no blind spot for disinfection and sterilization. On the other hand, UV sterilization is a direct irradiation, so a blind spot occurs.

(2) No harmful residue: Ozone has its oxidizing power to eliminate bacteria and poisons. Leaves no harmful residue. Contrary to this, the widely used chemical disinfectants are not only harmful to the human body itself, but also cause secondary contamination by harmful residues. Epidemic control in China has already brought serious problems due to the abuse of disinfectants.

(3) Convenience: The principle of ozone generation is simple, and it is not difficult to manufacture ozone production equipment. In addition, the size of the ozone generator varies, and it can be used in both private rooms and large spaces. Since it is easy to install, it can be installed on buses, railroads, ships, aircraft, etc.

The bactericidal and disinfecting effect of ozone is related not only to the concentration of ozone itself, but also to the temperature, humidity and exposure time of the environment. Furthermore, it has a certain relationship with the type of virus.

Whether or not it is effective against the new coronavirus was estimated by the following similar experiment, although there was no direct experiment at the time of the "February weekly paper".

According to the results of an ozone-induced SARS virus inactivation experiment conducted by Professor Lee Sawa, a professor at Beijing Institute of Technology and an expert on the Technical Committee of the China Ozone Industry Association, in 2003, ozone is resistant to the SARS virus. It has a strong inactivating effect, and the total mortality rate has reached 99.22% (hereinafter abbreviated as "Li experiment") [27] . This new type of

coronavirus belongs to the coronavirus as well as the SARS virus. Eighty percent of the genomic sequence of the new coronavirus is consistent with the SARS virus . [28]Therefore, it was inferred from the "February Weekly Paper" that ozone has considerable decontamination power against the new coronavirus.

Based on the above hypothesis about the sterilization and disinfection power of ozone in the natural world and the results of the "Li experiment", the "February weekly paper" states that "even if the ozone concentration is as low as that in the natural world, it will become a new coronavirus. On the other hand, it has a considerable inactivating power "(hereinafter abbreviated as" Hypothesis 3 "). Based on this hypothesis, the "February Weekly Paper" suggested that ozone could eliminate the new coronavirus and purify the air, and that it should be widely used in manned spaces.

Ozone has excellent decontamination and disinfection power against viruses, but it causes discomfort to people when it reaches a certain concentration, and it can also irritate the mucosal system, although there are individual differences. is there. Therefore, it has been mainly used in unmanned spaces so far. On the other hand, if the use of low-concentration ozone based on "Hypothesis 3" in a manned environment spreads to hospitals, workplaces, public spaces, public transportation, and indoors of houses, it can be said that it will be a great gospel for antivirus measures. ..

In the big cities of the concrete jungle, the ozone concentration is low in the first place . [29] This is even more so in a room where people gather. Now that the coronavirus is widespread worldwide, the use of ozone in manned spaces is the ultimate solution to the "three dense problems" [30] .

5. Ozone utilization and issues in measures against the new coronavirus

In order to solve the serious shortage of beds, Wuhan has built hospitals specializing in critically ill patients such as Huoshenshan Hospital and Leishenshan Hospital, which are quickly equipped with specialized treatment facilities with the support of the government. The former has 1,000 beds and the latter has 1,600 beds. Was secured. In addition, Wuhan has remodeled the gymnasium into 16 "Fangcang Hospitals" that accommodate mildly ill patients, quickly providing 13,000 beds with high antibacterial and antiviral levels, and achieving separate accommodation for mildly ill patients. It was.

The Far University Technology Group donated air purifiers with ozone generation function to many hospitals in Wuhan, including Huoshenshan Hospital, Leishenshan Hospital, and Fangcang Hospital . [31]It should be noted that a large amount of air purifiers with ozone generation function were donated to Wuhan Aoyama Fangcang Hospital and Wuhan Kusunoki Fangcang Hospital and started operation at the same time as the hospitals were opened. Fangcang Hospital, which was created by remodeling a gymnasium, had a very high risk of nosocomial infections because a large number of patients and medical staff were concentrated in a large room. However, no infected persons were found in the medical staff of the above two hospitals . [32]Ozone seems to have played a major role.

In the early days of the spread of the new coronavirus infection, lack of awareness of the nature of the virus, combined with a shortage of materials such as masks, protective clothing and isolation wards, put healthcare workers at high risk of infection. As a result, a large number of medical personnel in Wuhan were reduced due to infection. To that end, many medical workers from all over China rushed to Hubei Province, including Wuhan. Eventually, the number of health care workers who provided relief reached 42,000. Fortunately, none of these supportive healthcare workers were infected. It seems that the bactericidal action of ozone prevented hospital-acquired infections.

The biggest challenge for the widespread use of ozone is to spread a correct understanding of ozone.

On March 8, 2020, the Far University Technology Group was requested by South Korea to build an emergency hospital for coronavirus control with an air purifier that has an ozone disinfection and sterilization function. After that, the emergency hospital built at the China factory of the far-reaching university was transported to the site in South Korea and assembled, and became available on April 6. However, at the site in South Korea, there was strong resistance to the use of ozone, and in the end it was decided to turn off the ozone generation function attached to the air purifier. As you can see from these facts, the hurdles to the utilization of ozone are still high, and efforts to explain the safety of ozone to people are indispensable.

On September 1, at the request of the Ueno Ryokan Association in Tokyo, the author gave a lecture entitled "Learning from Wuhan, What We Can Do Now" at the Ueno Ward Community Center in Taito Ward . [33]We talked to hotel and restaurant owners about their knowledge of ozone and its potential use in combating the new coronavirus. After the lecture, 45 questionnaires were collected. Forty people answered "yes" to the question "Did you deepen your understanding of ozone?" I got the feeling that understanding of ozone

utilization can be obtained by making efforts to explain it. The sense of urgency created by the new coronavirus pandemic can be seen as an opportunity to dispel prejudices about ozone and open up new technological paths for the use of ozone in manned environments.

6. Confirmed inactivation of new coronavirus with low concentration ozone

Approximately three months after the publication of the "February Weekly Paper", on May 14, 2020, the public university corporation Nara Medical University announced that Professor Toshikazu Yano (Microbial Infectious Diseases) and Director Kei Kasahara (Infectious Diseases) A research group between the Center) and the MBT Consortium (member companies of the Infectious Diseases Subcommittee: Quall Holdings Co., Ltd., Sanyu Shoji Co., Ltd., Tamura Teco Co., Ltd., Marusan Pharmaceutical Biotech Co., Ltd.) It was announced that inactivation was confirmed (hereinafter abbreviated as "Yano-Kasahara experiment") . [34]

The "Yano-Kasahara Experiment" provided evidence that "ozone can inactivate the new coronavirus", which is the premise of the three hypotheses issued in the "February Weekly Paper". However, the ozone concentration used in the "Yano-Kasahara experiment" is as high as 6ppm and 1ppm, and it is assumed that ozone will be used in an unmanned situation.

On August 26, 2020, six months after the publication of the "February Weekly Thesis," a research group led by Professor Takayuki Murata (virus and parasitology) of Fujita Medical University conducted a low concentration (0.05). It was released experimentally for the first time in the world (hereinafter abbreviated as "Murata experiment") that ozone gas (ppm or 0.1ppm) has a decontamination effect on the new coronavirus. [35] ..

The "Murata experiment" is valuable evidence for "Hypothesis 3" of the "February weekly paper" that even ozone with the same concentration as in the natural world has a considerable inactivating power against the new coronavirus.

Furthermore, in the "Murata experiment", the decontamination effect of ozone on the new coronavirus was improved when the humidity increased. Therefore, in "Hypothesis 2" of the "February week paper", the improvement in humidity is ozone. We provided evidence for the new coronavirus to the theory that it would increase the virus inactivating power of the virus.

The gathering of such valuable evidence has greatly supported the countermeasures against the new coronavirus by using ozone in a manned environment.

7. Development of high-precision and inexpensive ozone sensor is the key

However, another decisive factor is required for the full-scale use of the new coronavirus countermeasures by using ozone in a manned environment. It is a sensor that controls low levels of ozone concentration.

Incorporating ozone at a concentration close to that of nature does not cause discomfort to people. However, while having a certain inactivating power for the new coronavirus, the concentration of ozone in the room is maintained at the same level of 0.05ppm to 0.1ppm [36] as in the "Murata experiment" so as not to affect the human body . It is difficult. Since ozone has extremely unstable properties, it is always necessary to measure the concentration with high accuracy in order to control it to a constant concentration. The problem is that ozone sensors, which measure low concentrations of ozone with high accuracy, are currently very expensive . [37] Since high-precision ozone sensors cannot be used easily, there are no popular ozone generators that can control low-concentration ozone at a low price.

If it is cheap and the ozone concentration can be controlled safely, the use of ozone will be easily accepted by the world, and the use of ozone in manned spaces will be promoted at once. The development of an inexpensive ozone sensor while maintaining high accuracy should be tackled as an urgent issue. Of course, now that we are exposed to the threat of the new coronavirus, there is an urgent need to spread the indoor use of ozone by various means even without cheap and accurate sensors.

The relationship between ozone and microorganisms represents the perfect balance of life on Earth. Without the protection of the ozone layer, microorganisms such as viruses and bacteria could not exist. On the other hand, the strong oxidizing power of ozone is also a natural enemy of viruses. Mankind is still poorly aware of ozone. The author thinks that prejudice against ozone and excessive caution should be abandoned, many mysteries related to ozone should be solved, and the characteristics of ozone should be fully understood and utilized. Especially in the fight against this new coronavirus, it is urgent to make full use of the power of ozone.

[1] Muzhi Zhou, "This Individual" Shinki "Noh Virus New Crown Disease Toxic", China Internet Information Center (China.com.cn), February 18, 2020 (http://opinion.china.com.cn/opinion_84_217684.html) ..

[2] Zhou Muzhi, “Ozone: a powerful weapon to combat COVID-19 outbreak” In *China.org.cn* , 26 February 2020 (http://www.china.org.cn/opinion/2020-02/26/ content_75747237.htm).

[3] Muzhi Zhou "Eradication of the New Coronavirus with Ozone Power", In *Japanese.China.org.cn* , March 19, 2020 (http://japanese.china.org.cn/business/txt/2020-03/19 / content_75834590_2.htm).

[4] Zhang thermocline Mr. In 1988, far-reaching Technology group founded the (BROAD Group), China entrepreneurs to the representative that helped grow the company to the non-power air conditioning manufacturer of the world's largest. Since mid-January 2020, the author has been discussing ozone with him online day and night.

[5] Ultraviolet rays are classified into UV-A (315-400 nm), UV-B (280-315 nm), and UV-C (<280 nm) according to the wavelength, and most of UV-B that is particularly harmful to living organisms. All of UV-C is absorbed by the ozone layer.

[6] About 2.8 billion years ago, primitive plants (lansaws) emerged on the earth and photosynthesis began. Photosynthesis increased the oxygen concentration in the atmosphere, and the ozone layer was formed about 400 million years ago, allowing organisms to live on land without water protection. For more information on this, see Hajime Akimoto, "CFCs and Stratospheric Ozone," The Chemical Society of Japan, "Chemistry and Education," Vol. 36, No. 6, December 20, 1988, pp.554-557.

[7] "Many of these substances, which emit ozone-depleting substances containing chlorine and bromine atoms by human activities, are extremely stable and inreactive, and do not dissolve in rain or seawater. It has an extremely long life in the atmosphere and accumulates in the lower tropospheric atmosphere (some of the short-lived ones accumulate in the atmosphere). These are transported to the stratosphere through atmospheric motion, albeit very slowly. There, it is decomposed by short-wavelength solar ultraviolet rays that are not shielded by the ozone layer and converted into highly reactive substances. The resulting reactive substances destroy tropospheric ozone by a chain reaction. " Excerpt from "Part 2 Atmospheric Concentrations of Specified Substances, etc.", Ministry of the Environment, "Annual Report on Monitoring Results of Ozone Layer, etc. in 2018", August 2019, p91.

[8] "In general, the shorter the wavelength of ultraviolet rays, the greater the harmful effects on living organisms, but UV-C is completely absorbed by oxygen molecules in the upper atmosphere and ozone in the stratosphere, so the amount of ozone decreases slightly. However, it does not reach the ground surface and does not pose a problem to living organisms. Also, the amount of UV-A irradiation is almost unaffected by changes in the amount of ozone. Regarding UV-B, recent findings have shown. For example, a 1% decrease in stratospheric ozone has been shown to increase by about 1.5% at certain solar altitude angles (23 degrees). UV-B damages important biological substances such as nucleic acids. In addition to affecting human health such as skin aging, an increase in the incidence of skin cancer, an increase in the incidence of cataracts, and immunosuppression, there is concern that it will adversely affect terrestrial and aquatic ecosystems. " Excerpt from "Part 3 Status of Solar Ultraviolet Rays", Ministry of the Environment, supra report, p.139.

[9] In 1974, Professor Roland and Dr. Molina of the University of California pointed out for the first time that chlorofluorocarbons (CFCs) would destroy the ozone layer. Taking this opportunity, efforts to protect the ozone layer were promoted. In 1985, the "Vienna Convention for the Protection of the Ozone Layer" was adopted, and in 1987, the "Montreal Protocol on Substances that Deplete the Ozone Layer" was adopted. The production and consumption of ozone-depleting substances have been reduced by setting a deadline. In 2016, an amendment was agreed to add CFC substitutes (HFCs), which are not ozone-depleting substances but have a high greenhouse effect, as substances subject to gradual reduction. The revised protocol came into effect on January 1, 2019. For details on the history of international efforts regarding ozone layer protection measures, refer to "Part 4, Appendix 1-3. International Ozone Layer Protection Measures," the above-mentioned report of the Ministry of the Environment, pp.188-192.

[10] Ozone is an allotrope of oxygen consisting of three oxygen atoms , and its molecular formula is O3. It is a colorless gas with a boiling point of -111.9 ° C, strong oxidizing power, and a peculiar odor at room temperature.

[11] In addition to the FDA, the US government has set standards or recommended concentrations for ozone exposure. A table summarizing each standard is posted on the homepage of the US Environmental Protection Agency (USEPA). For more information on this, see "Ozone Generators that are Sold as Air Cleaners", US Environmental Protection Agency (USEPA) HP (https://www.epa.gov/indoor-air-quality-iaq/ozone-generators-are- See sold-air-cleaners , last viewed: September 7, 2020).

[12] The recommended year for ozone permissible concentration is as old as 1963, and has not been revised since then. For details, refer to "Recommendations for Allowable Concentrations, etc.", Japan Society for Occupational Health, "Journal of Industrial Hygiene," Vol. 61, No. 5, May 12, 2019, p.172.

[13] China National Ministry of Health (Ministry) "Ozone Ozone Generator Safety and Hygiene Standards", December 30, 2011.

[14] Reported that the increase in tropospheric ozone since the Industrial Revolution was much higher in the Northern Hemisphere than in the Southern Hemisphere, and that tropospheric ozone had increased to become a second greenhouse gas surpassing CH4 in the Northern Hemisphere. Has been done. For more information on this, see Hajime Akimoto, "Climate Change and Atmospheric Environment," Atmospheric Environment Society, Journal of the Atmospheric Environment Society, Vol. 44, No. 6, December 10, 2009, p.398.

[15] It has been reported that ozone concentration has increased from about 10 ppbv to about 45 ppbv in the last 100 years. For more information, see Alain Marenco, Hervé Gouget, Philippe Nédélec, Jean-Pierre Pagés, Fernand Karcher, “Evidence of a long-term in-crease in tropospheric ozone from Pic du Midi data series: Consequences: Positive radiative forcing”, in *Journal of See Geophysical Research* , Vol.99, 20 Aug 1994, pp.16617-16632.

[16] The amount of ozone varies depending on the latitude / longitude and season due to changes in solar ultraviolet irradiation and the mechanism of ozone transport in the atmosphere. For details on this, refer to the above-mentioned report of the Ministry of the Environment, "Part 1 Ozone Layer Status," pp9-13.

[17] There are few academic treatises and editorials that positively capture the role of ozone in the tropospheric nature. Although it is not academic, it is valuable because there is a positive commentary on tropospheric ozone on the website of Ecodesign Co., Ltd. (https://www.ecodesign-labo.jp/ozone/ozone/ , last viewed: September 6, 2020). is there.

[18] There is a report that the removal effect of airborne virus was confirmed by exposure to 0.025ppm low concentration ozone. For more information on this, Katsuhiko Nakamuro, Akira Okagami, Koji Tsuda, "Effects of removing airborne viruses by a small low-concentration ozone generator," Japan Medical and Environmental Ozone Society, "Journal of the Japanese Medical and Environmental Ozone Society," Vol. 22, No. 3. See pp.73-77, August 2015. In addition, it has been reported that low-concentration ozone has a bactericidal and antifungal effect on vegetables such as spinach, lettuce, and strawberries. For more

information on this, see Akira Ikeda, Yoshitaka Kawaso, Kenji Esaki, Shigeki Nakayama, "Sterilization of vegetables during low-temperature storage with low-concentration ozone," Japan Society for Bio-Environmental Engineering, "Journal of the Plant Factory Society," Vol. 10, No. 4, December 1998. See pp.237-242 on the 1st of the month.

[19] It has been reported that the relationship between influenza virus epidemics and seasons correlates with absolute humidity rather than relative humidity. For details, see Makoto Shoji, "Seasons and Influenza Pandemic," National Institute of Public Health, "Public Health Research," Vol.48 (4), December 1999, pp.282-290. In addition, from the experimental results on the infection rate and survival rate of influenza virus, it has been reported that when the absolute humidity is low, the survival period of influenza virus is extended and the infection rate is increased. For more information, see Jeffrey Shaman, Melvin Kohn, “Absolute humidity modulates influenza survival, transmission, and seasonality”, in *Proc Natl Acad Sci USA* , Vol.106, 10 Mar 2009, pp.3243-3248.

[20] Ozone is easily affected by humidity, and it has been reported that the decontamination effect rate (decontamination ability) decreases in a low humidity environment. For more information, see Miei Sakurai, Ryoji Takahashi, Sakae Fukunaga, Shigefumi Shiomi, Koji Kazuma, Hideharu Shintani, “Several Factors Affecting Ozone Gas Sterilization”, in *Biocontrol Science* , Vol.8 (2), 10 Jun 2003, pp.69-76 See.

[21] Influenza "peaks in December-March in the Northern Hemisphere and in June-September in the Southern Hemisphere. It does not form a clear peak around the equator and occurs year-round," Akihiko Kawana "Influenza (seasonal). (Sex) ”(July 23, 2019), Japan Infectious Diseases Society website (http://www.kansensho.or.jp/ref/d04.html , last viewed: September 6, 2020).

[22] The total amount of ozone is the total amount of all ozone contained in the vertical air column from the surface of the earth to the upper end of the atmosphere, and the unit matm-cm (milliatom centimeter) is assumed to be 0. Represents the thickness when collected on the surface at °C and 1 atm.

[23] For details on the data of the Japan Meteorological Agency ozone observation point, see "Data on the ozone layer", Japan Meteorological Agency website (https://www.data.jma.go.jp/gmd/env/ozonehp/info_ozone.html , last viewing date). : September 7, 2020).

[24] For details on the global distribution of ozone content, see "Part 1 Ozone Layer Situation," Ministry of the Environment, supra report, p.11.

[25] The half-life of ozone has been reported to depend on relative humidity and airflow in addition to temperature. For details, refer to "Measured value of self-decomposition rate of gaseous ozone", Kansai Ozone Technology Study Group "Technical Note", No.17, July 8, 2012, pp.1-4.

[26] Regarding indoor environment decontamination using ozone gas, it has been reported that the killing rate of the virus to be killed increases as the relative humidity rises. For details, see Hiroshi Sato, Yoji Watanabe, Hironori Miyata, "Inactivation of Experimental Animal Viruses by Ozone," Japan Experimental Animal Society, "Experimental Animals," Vol. 39, No. 2, April 1, 1990, pp.223-229.

[27] For more information on the ozone-induced SARS virus inactivation experiment conducted by Professor Lee Sawa, see the Beijing Daily article dated November 6, 2003.

[28] "The gene of the new coronavirus is highly homologous to the gene of SARS coronavirus (about 80%)", Yoshiharu Matsuura, Wataru Kamiya "About the new coronavirus infection" (February 10, 2020), Japanese Society of Virology website (http://jsv.umin.jp/news/news200210.html , last viewed: September 6, 2020).

[29] It has been reported that ozone concentration is seasonal and is greatly influenced by altitude, weather, and topography near the observation point. There is a research report that compares the ozone concentration of Maunarowa (Hawaii), Arosa (Switzerland), London, and Tokyo, and shows that the ozone concentration of London and Tokyo is lower than that of Maunarowa and Arosa. In urban areas, areas with high ozone concentration are generated locally due to the influence of automobile exhaust gas and the like. For more information on this, Kiyoshi Kawamura, "Mechanism of Atmospheric Ozone Generation, Ozone Concentration on the Ground Surface and Its Measurement Method," Japan Rubber Association, Japan Rubber Association Magazine, Vol. 40, No. 4, April 15, 1967, pp.262 See -269.

[30] "Three Cs" is a slogan raised by the Cluster Countermeasures Group of the Ministry of Health, Labor and Welfare in March 2020 to prevent outbreaks during the expansion of the new coronavirus infection (COVID-19). The Japanese government has set out as a preventive measure against the spread of the new coronavirus infection to avoid sealing, crowding, and close contact.

[31] A total of 22 TB100 (ozone generation capacity 1g / h / unit) air purifiers with ozone generation function of the Far University Technology Group donated and purchased to Wuhan Aoyama Hospital and Wuhan Kusunoki Hospital. , TA2000 (ozone generation capacity 7g / h / unit) was 35 units, and TD5000 (ozone generation capacity 14g / h / unit) was 12 units.

[32] According to an interview with the person in charge of the Far University Technology Group.

[33] Sadatoshi Watanabe, the head of the Ueno Ryokan Association, asked the author for his cooperation as he wanted to find a way to counter the new coronavirus caused by ozone while the hotel industry was hit hard by the corona disaster and it was difficult to attract customers. .. The lecture on September 1, 2020 was held as part of this trend. See page 1 of the Taito Ward Citizens' Newspaper on September 20 for the lecture. After that, lectures on the spread of ozone were held three times for those involved in the hotel industry.

[34] For more information on the "Yano-Kasahara Experiment," see Nara Medical University Press Release (http://www.naramed-u.ac.jp/university/kenkyu-sangakukan/oshirase/r2nendo/documents/press_2.pdf , Last viewed: September 6, 2020).

[35] For more information on the "Murata Experiment," see the Nara Medical University press release (https://www.fujita-hu.ac.jp/news/j93sdv0000007394.html , last viewed: September 6, 2020). reference.

[36] The reason why the "Murata Experiment" set the ozone concentration to 0.05ppm to 0.1ppm is probably because the Japan Society for Industrial Health stipulates that the allowable ozone concentration of the industrial environmental standard is 0.1ppm. Will. In view of the With Corona era, it will be important to relax these standards to some extent in order to further enhance the inactivating power of ozone against the new coronavirus.

[37] The ozone sensor from 2B Technologies of the United States is highly accurate but expensive. For example, the company's UV absorption ozone monitor POM and UV absorption ozone meter Model 106-H are priced at 1,120,000 yen and 960,000 yen in Japan, respectively. The price is not suitable for the widespread use of ozone.

"*Economics, Journal of Tokyo Keio University*" No. 307, published on December 2, 2020

NEWS