EUROPEAN JOURNAL OF MATERIALS SCIENCE AND ENGINEERING
Volume 11, Issue 02, 2026: 129-136 | www.ejmse.ro | ISSN: 2537-4338

EJMSE

DOI: 10.36868/ejmse.2026.11.02.129

DISINFECTION SYSTEM BY PULSE CORONA HYBRID TECHNOLOGY

Siseerot KETKAEW[1][0009-0006-2094-5011]

[1] Faculty of Engineering, Ramkhamhaeng University, Ramkhamhaeng Road, Huamark, Bangkapi, Bangkok Thailand

Abstract

This research introduces methods for designing and constructing disinfection systems using hybrid corona pulse technology. Adopt the principle of corona discharge, combined with negative charge and desulfurization technology to maintain frequency. In high voltage circuits, using a IC#TL494 as a pulse generator can adjust the duty cycle by 8%, 16%, 33%, and 41%, and adjust the switching frequency to 20 kHz is used to drive the Power MOSFET#IRFP460 for control the operation of the high-voltage switching transformer at 1.0 kV, 2.9 kV, 3.2 kV, and 4.9 kV, using loads as electrode cells (cell corona for ozone gas generation and negative charge cell). Increasing the high voltage, the amount of ozone and negative charge will also increase. When testing at duty cycle 8%, high voltage 1.0 kV, ozone 1.28 ppm, and electric charge - 1.2 kV. At duty cycle 16%, high voltage 2.9 kV, ozone 1.56 ppm and electric charge -2.6 kV. At duty cycle 33%, high voltage 3.2 kV, ozone 2.35 ppm and electric charge -3.8 kV, and duty cycle of 41%, high voltage 4.9 kV and electric charge 2.61 ppm and electric charge -4.5 kV can be used to remove microorganisms from the air to reduce their content, and are tested in the computer room of the School of Engineering, Ramkhamhaeng University, with a room area of 100 square meters. The test result is disinfection system with hybrid corona pulse technology have analyzed the electrical leakage safety standard analysis (IEC 60335-1), and tested total power consumption have been completed. Therefore, this research project can be further developed into commercial innovations in the future.

Keywords: *Hybrid corona pulse technology, disinfection system, corona discharge, ozone generation, airborne microorganism removal.*

Introduction

The problem of the outbreak of COVID-19 originated in Wuhan Province. People's Republic of China but the new corona virus has It has spread all over the world and the Health Organization has declared it a pandemic disease on February 26, 2020 [1]. The nature of dental services is at risk of person-to-person transmission. It was found that contact can occur with both dental personnel and service users [2]. It is therefore imperative to strictly implement infection prevention measures in epidemic areas. The main channels of human-to-human transmission are droplets and close proximity. If there is an infection, it can enter the body through the oral cavity or the conjunctiva [3]. Once the patient has been infected, it will spread to 2-3 people in the same period. The average incubation period is about 5 days with incubation ranging from 1 to 14 days and patients usually start on day 12.5 after entering the body (representing 95%), many studies have set a surveillance period of 14 days to monitor (quarantine) to avoid contact with infected people in all cases [4]. However, the infected person may be asymptomatic and may be a latent carrier for up to 19 days. Some patients may have no symptoms. to severe symptoms until respiratory failure [5]. The main symptoms are fever, muscle aches, dry cough, fatigue, shortness of breath, phlegm, headache, cough with blood and diarrhea, often with symptoms similar to

*Corresponding author: siseerot@hotmail.com

severe pneumonia and very severe, there will be chest pain [6-7]. From the aforementioned problems The researcher therefore designed and built the machine reduces the amount of germs in the air and on various surfaces to eliminate various germs such as bacteria, viruses and other microorganisms which are aerosols blown in the air and surfaces of various materials to reduce or disappear by using high voltage electrical energy to produce ion plasma which has applied high voltage engineering technology used to create a high-frequency pulsed electric field to produce high-intensity plasma and high-density ions [8-10].

The machine consists of 2 main parts: part 1 is a design to create a high-voltage circuit that can adjust high-frequency pulse voltage from 1 kilovolt or more to supply electrical energy to the corona producing cells and negative ions. Part 2 is the design and construction of the corona producing cells and negative ions in the corona discharge process [11-12]. It consists of a series of fine electrodes to produce negative ions. and a series of pointed and planar electrodes are placed in parallel to generate a highly non-uniform electric field to produce corona by using high-frequency modulation to control high voltage pulses.

Materials and Methods

Research objectives

1. To design and build a pathogen elimination system with hybrid corona pulse technology to be used to eliminate the amount of germs in the air and various surfaces in hospitals or elderly care centers or laboratories, Faculty of Engineering Ramkhamhaeng University or places.

2. To design and build high-frequency pulse high voltage circuits and an embedded system for controlling the operation of the corona and negative ions cell set, timer system and other systems within the machine to work together effectively.

3. To test and analyze electromagnetic compatibility standards (EMC Testing), analyze the overall power consumption (Power Consumption) and analyze the safety standards for leakage of electricity (IEC60335-1) for the safety of people active and test the actual use along with measuring the amount of pathogens in the air and on various surfaces which in the future can support the production and distribution for commercial purposes to be taken out as a product.

4. To improve the health quality of life of medical personnel and people who come to use the service in hospitals, field hospitals and places to have better health and safe against germs which leads to the sustainable development of the country.

Research methods

High density electric charge (ion) technology used in the research project

High ion density technology is a system based on the principle of emitting high concentrations of particles into the air. This particle is an electric particle. Also known as ions by releasing a positive electric charge (H+) and a negative electric charge (OZ-) alternately which is the same type that exists in nature into the air at the same time to destroy the walls of fungal cells (Mold), viruses (Virus) and bacteria (Bacteria). Overall, the real benefit is Virus: killing various viruses. that float in the air, Allergy: decomposes allergens, Odors: decomposes unpleasant odors (rotten, rotten or fart smells can help), Mold: decomposes mold, Bacteria: kills bacteria in the air.

Corona technology (corona discharge process) used in the research project

It is a process that can produce ozone gas. It has been proven to kill 99.97% of airborne germs, including SARS coronavirus and influenza viruses such as H5N1. Ozone is therefore an important tool in preventing the spread of disease (COVID-19). Ozone concentration standard for virus removal 0.5 - 1.5 PPM (0.982 mg/m3 or about 1 mg/m3) can eliminate 99% of viruses, with a disinfection time of at least 4 minutes* It is a level that is sufficient to kill the virus. In addition, it can disintegrate quickly, no more than 20 minutes * (Source: https://www.ozonic.co.th/).

Therefore, ozone gas can be applied in disinfection. Because ozone gas is a substance that Properties as a strong oxidizer (Strong Oxidizing) uses the principle of taking electrons out of other reactants during the redox reaction (Oxidation-Reduction (Redox) Reaction) Ozone gas is normally a health hazard if inhaled or directly exposed to high concentrations of ozone gas. But if there is a proper amount of control and following the right steps, it can be used to eliminate viruses in the air and on surfaces without harming the body. Because after using ozone gas to kill the virus, the only thing left is oxygen gas without any chemical residue. In addition, the duration of disinfection is shorter than the use of UV radiation, meaning that the concentration of ozone gas that can kill germs must be at least 0.5 - 2.5 ppm (parts per million or parts per million) with a duration of 2 minutes to kill the virus. In the case of killing bacteria, it takes longer. As for the concentration of ozone gas that is safe for the body, the 8-hour average should be lower than 0.10 ppm (Source: https://siamrath.co.th/n/149956).

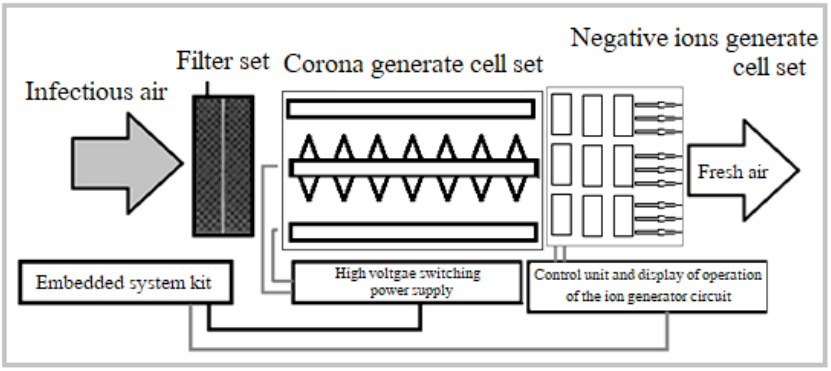


Fig. 1. Internal structure of the pathogen removal system with hybrid corona pulse

Work flow internal structure of operation of disinfection system with hybrid corona pulse technology as follows:

1. The air filter is a filter that traps large particles of 0.01 micron dust.
2. The corona production cell. serves to produce corona (ozone gas) used to eliminate various germs in the air and eliminate various unpleasant odors.
3. To destroy pathogens in the air and on surfaces.
4. Serves to supply electrical energy to the corona producing cells. and high density negative ion production cells.
5. Control and display of negative ion production acts to control and display the performance of high-density negative ion production.
6. Set of embedded systems for controlling various systems.

Technology electric field technology

To be applied to high intermittent electric field corona producing cells. The corona producing cell has the opposite voltage. If considering the electric field stress of the corona producing cell, it follows the equation equal $E = \frac{V}{d \times \eta^*}$ where the corona producing cell. It consists of a pointed electrode placed at a distance of 1 centimeter from the plane electrode to eliminate germs and eliminate unwanted odors. completed, as shown in Fig. 2.

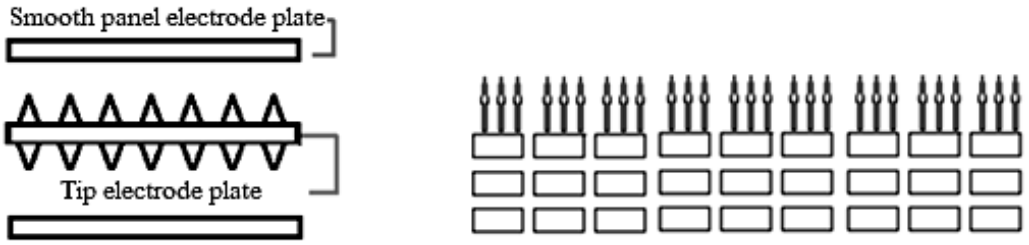


Fig. 2. (a) corona producing cell and (b) high density negative charge producing cell

Design and construction

Design and construction of a disinfection system using hybrid corona pulse technology

Explore the laboratory area, Faculty of Engineering Ramkhamhaeng University or places to be used in the design of various parts of the disinfection system (Test area size 100 square meters).

Designing and constructing high voltage electrical circuits for supplying electrical energy to corona generator and negative ion cells

This research project has been divided into 6 parts as follows:

1. Rectifier and input filter section.
2. Converter circuit (power circuit) section.
3. Control circuit and gate drive section.
4. High voltage switching transformer.
5. Corona generator cell.
6. Negative electric charge cell.

Part of the high voltage power supply

Part of the disinfection kit in surface air and get rid of various unpleasant odors

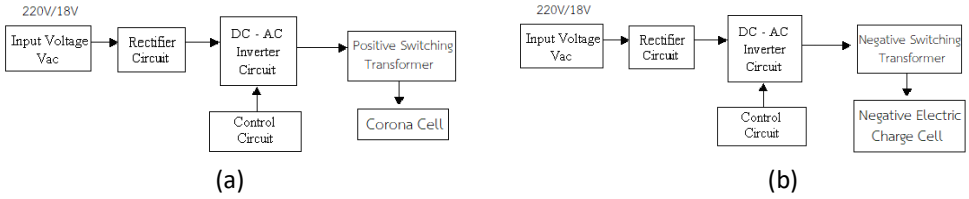


Fig. 3. (a) Block diagram of the high voltage circuit of the corona generator cell and (b) block diagram of the high voltage circuit of the negative charge generator cell

From Fig. 3, when the AC 220 volts, 50 Hz is fed into the transformer 220 volts / 18 volts, then it passes through the rectifier and filter circuit. Resulting in a voltage of 25volts DC to be supplied to the input side of the circuit. Flyback converter which has IC number TL494 as a PWM (Pulse Width Modulation) control circuit for the power MOSFET in the converter circuit to control high voltage power supply (where the switching frequency can be adjusted relative to the high voltage output) to supply the corona producing cell and negatively charged cells.

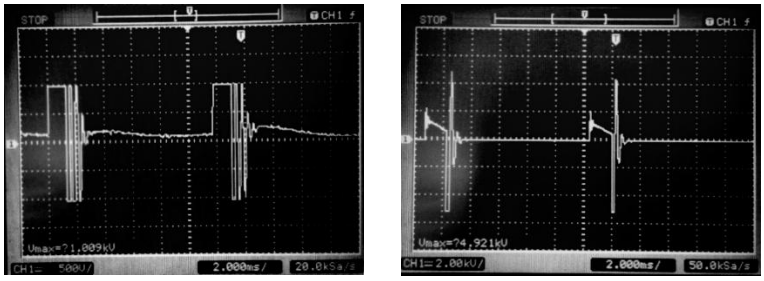
Internal and external casing, disinfection system with hybrid corona pulse technology. To support the size of the circuit, control system, timer system and other systems are completed as in Fig. 4.

Fig. 4. Internal and external casing of the disinfection system using hybrid corona pulse technology. Compatible with circuit sizes, control systems, timers, and other systems

Results and discussions

Test results of high voltage circuit.

The output signal test is the high voltage signal on the output (VOUT) of the high voltage switching transformer at duty cycle 8% and 41% while the corona producing cell is connected as shown in the Fig. 5.



(a) (b)

Fig. 5. (a) High voltage output (VOUT) 1 kV signal of a high voltage switching transformer at duty cycle 8% and (b) high voltage output (VOUT) 4 kV signal of high voltage switching transformer at the duty cycle 41% while connecting the cell to produce corona

Fig. 5 is the measurements of the output signal, that is, the high voltage output (VOUT) signal of the high voltage switching transformer. The test results can be seen that when the duty cycle increases, the high voltage output increases as well while connecting the corona producing cell. Leakage current safety standard analysis test (IEC 60335-1) and total power analysis test completed, as shown in Fig. 6.

Fig. 6. Leakage current safety analysis test (IEC 60335-1) and total power analysis test is completed

The test result is a disinfection system with hybrid corona pulse technology. Passed leakage current safety analysis (IEC 60335-1) and total power consumption (Power Consumption). at PTEC testing room. Test results for adjusting the duty cycle of high voltage circuits to feed the corona producing cells with the amount of ozone produced as shown in table 1.

Table 1. Test results of adjusting the duty cycle of the high-voltage circuit to feed while connecting the corona production cell with the amount of ozone gas produced

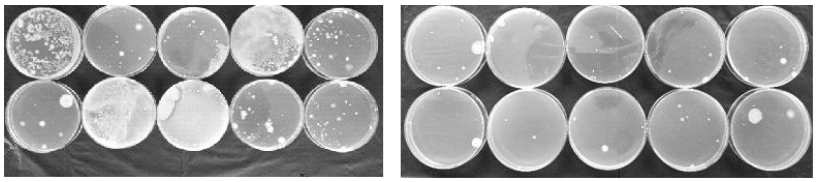
Duty Cycle (%)	$V_{in\ (rms)}$ (V)	$I_{in\ (rms)}$ (A)	V_{OUT} (kV)	Amount of Ozone Gas Produced (ppm)
8	220	0.53	1.0	1.28
16	220	0.61	2.9	1.56
33	220	0.72	3.2	2.35
41	220	0.84	4.9	2.61

The meaning of the parameters in Table 1
Duty Cycle is Duty Cycle (%)
$V_{in(rms)}$ is the AC input voltage of the high-voltage power supply (volts), V
$I_{in(rms)\ is}$ the input AC current of the high-voltage power supply (amperes), A
V_{OUT} is the high-voltage AC output voltage of the high-voltage power supply, (kilovolt), kV

The test results measure the amount of electric charge production of the electric charge set

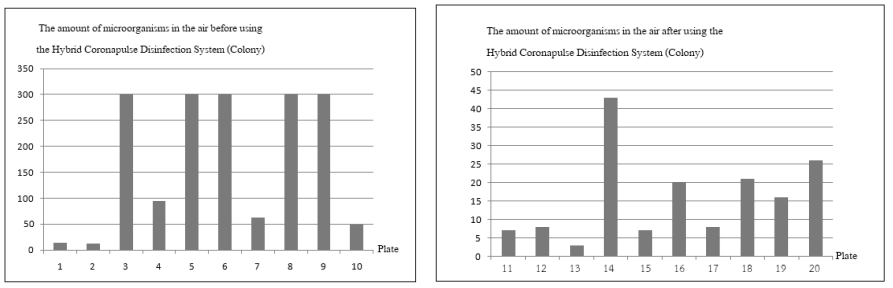
The relationship between the time of the test and amount of electric charge production of the electric charge generator, (Tested to measure the amount of electric charge produced 10 times and taken to find the average value), (electric charge produced 2,579 x 104 ions/cm3 with KT-401 AIR ION TESTER). The result is that the test time is 20 minutes. Electric charge production equal - 1.85 kV, test time 40 minutes will produce electric charge equal - 2.73 kV and test time 60 minutes will produce electric charge equal - 3.96 kV.

Measurement test results the amount of microorganisms before and after the disinfection system using hybrid corona pulse technology, test time 60 min), and as shown in Fig. 7(a), Fig. 7(b), Fig. 8(a) and Fig. 8(b).



(a) (b)

Fig. 7. (a) The microbial loads measured in the air before using the hybrid corona pulse disinfection system and (b) the microbial loads measured in the air after using the hybrid corona pulse disinfection system



(a) (b)

Fig. 8. (a) Test results measuring microorganisms in the air before using the hybrid corona pulse disinfection system and (b) Test results measuring microorganisms in the air after using the hybrid corona pulse disinfection system

The test results were that the microbial count in the air before using the hybrid corona pulse disinfection system was greater than 300 colonies and the microbial count in the air after using the hybrid corona pulse disinfection system. The corona pulse was 3 colonies and no microbial load was detected. The results obtained from measuring the amount of microorganisms in the air showed that the amount of microorganisms in the air after using the hybrid corona pulse disinfection system. There will be less in the air.

Conclusions

From testing the disinfection system with hybrid corona pulse technology. The test was divided into 4 parts as follows: Part 1 : Tested the high-voltage circuit for the corona-producing cell set. The test result was that when the duty cycle was adjusted, the high voltage would increase by feeding it to the corona production cell set As a result, the amount of ozone gas increased, respectively. Part 2 : When measuring the amount of negative ion production of the electric ionizer, it was found that when the test time increased will also increase the amount of electric charge. A test was performed to measure the amount of electric charge produced 10 times and averaged. (Electricity produced 2,579 x 104 ions/cm3 by KT-401 AIR ION TESTER) and the amount of ozone gas and negative ions produced will be tested for eliminating germs in the air.

Part 3 : The results of the test measure the microbial count in the air before using the hybrid corona pulse disinfection system was greater than 300 colonies and the microbial count in the air after using the hybrid coronavirus disinfection system. The corona pulse will be reduced to 3 colonies (testing time 60 minutes), test room area 100 square meters.

Part 4: Disinfection system with hybrid corona pulse technology passed the electrical leakage safety test (IEC 60335-1) and the total power analysis test (Power Consumption) at the testing room of the Electrical and Electronics Testing Center (PTEC) as already.

Which in the future can support the production and distribution for commercial purposes to be taken out as a product bring income back to the country and the important thing is helping to improve the health quality of life of medical personnel working and people who come to use the service in hospitals, field hospitals and places to have better health which leads to the sustainable development of the country.

Acknowledgments / Funding body

Thank you for the National Budget Research Fund. Science, Research and Innovation Promotion Fund Fiscal Year 2023 of Ramkhamhaeng University for supporting this research project. Thank you to Director of Research and Development, Ramkhamhaeng University that provide support and suggestions for this research project until accomplished well. Thank you Mr.Punthep Choosakul for helping and giving advice on the electric charge measuring instrument. Thank you, Staff of Faculty of Engineering, Ramkhamhaeng University for providing tools and equipment used in research. And thank the family of the researcher who encourages and helps in all aspects of research Until accomplishing well.

References

[1] S. Dan, *Switching Power Supply in Color Television Sets*. Bangkok, Thailand: Entel Thai Co., Ltd., 1995.

[2] N. Mohan, T. M. Undeland, and W. P. Robbins, *Power Electronics: Converters, Applications, and Design*, 2nd ed. New York, NY, USA: John Wiley & Sons, 1995.

[3] J. M. Alonso, J. Cardesín, E. L. Corominas, M. Rico-Secades, and J. García, "Low-power high-voltage high-frequency power supply for ozone generation," *IEEE Transactions on Industry Applications*, vol. 40, no. 2, pp. 414–421, Mar./Apr. 2004, doi: 10.1109/TIA.2004.824498.

[4] G. Chryssis, *High-Frequency Switching Power Supplies: Theory and Design*, 2nd ed. New York, NY, USA: McGraw-Hill, 1989.
[5] S. Ketkaew, "Plasma ozonizer using micro-converter for ammonia (NH_3) decreasing in shrimp food production," *Procedia Engineering*, vol. 32, pp. 148–154, 2012, doi: 10.1016/j.proeng.2012.01.1249.
[6] S. Dan, *Switching Power Supplies in Color TV Receivers*. Bangkok, Thailand: Entel Thai Co., Ltd., 1995.
[7] Texas Instruments, "TL494 pulse-width-modulation control circuits," TL494 Datasheet, Literature no. SLVS074I, rev. I, Jul. 2022.
[8] Department of Dental Health, Ministry of Public Health, Thailand, "[Online document]." [Online]. Available: http://dental.anamai.moph.go.th/dm_km/upload_dm_km/data_150wasinee.pdf. Accessed: Nov. 9, 2020.
[9] ThaiTechno.net, "Product details," [Online]. Available: http://thaitechno.net/t1/productdetails.php?id=8821&uid=2875. Accessed: Oct. 5, 2020.
[10] S. Ketkaew, "Use of thermoelectric for reducing temperature of cell electric field corona of smell eliminator," *European Journal of Materials Science and Engineering*, vol. 3, no. 2, pp. 93–97, 2018.
[11] S. Ketkaew, "High density cold corona generator for increase oxygen in water storage," *European Journal of Materials Science and Engineering*, vol. 5, no. 2, pp. 94–99, 2020, doi: 10.36868/ejmse.2020.05.02.094.
[12] S. Ketkaew, "Development of electric charge generator by applied pulse high intensity electric field," *European Journal of Materials Science and Engineering*, vol. 4, no. 3, pp. 114–120, 2019, doi: 10.36868/ejmse.2019.04.03.114.

Received: March 03, 2026
Accepted: May 29, 2026