Disinfection apparatus for rice germ and packaging room

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Abstract. This paper presents the design and construction of disinfection apparatus for rice germ and packaging room by ripple pulse corona energy using adjust electric field intensity. Using flyback converter principle and controlling of the switching by IC#SG3526. The flyback converter is designed to operate at 20-25 kHz frequency through a DC high voltage high frequency transformer at output voltage of 1 kV to 5 kV, and at the input voltage of 24 VAC, By adapting the stainless tips between aluminium net in electrode cell set, one - hour operating yields the ozone gas (O$_3$) generating capacity of 2.5 ppm to 5.5 ppm and at 3.7 ppm enables eliminate diseases in rice germ and packaging room. In the future can be developed apparatus in the commercial of Thailand 4.0.

1. Introduction

At present, the disinfection machine has been able to use ozone gas for daily use. In practice, it can be seen that ozone gas has both advantages and disadvantages. Which depends on how much ozone will be used. Therefore resulting in the idea of adjusting the amount of ozone gas to maximize the benefits to the industry and society by using development methods and relying on adjusting the electric field intensity (i.e. high voltage adjustment) to control the amount of ozone gas. Where this gas can be obtained from Oxygen molecule breakdown which creating a high-voltage switching power supply has introduced the IC number SG3529 as a pulse modulator and is a control circuit for switching power MOSFETs in the sector.

Flyback converter with a high-frequency high-voltage transformer that acts as an induction pulse to create high voltage electricity applied to the corona cell set by electrical energy from the corona cell set is a factor that directly affects performance. And the type of material used to make corona cells must be conducive to the process Corona Discharge also to cause the breakdown of oxygen molecules from the equation, O$_2$ + O → O$_3$.

Therefore, this innovative research has already been utilized at community enterprises. In the case of sterilization of the nose packaging bottle to increase the value of the product and respond to the community development policy of the nation

2. Materials and methods

2.1. Purpose

- To design and build a sterilizer by using the corona discharge principle to produce ozone
- To apply the sterilizer to use in the bottle of rice germ of community enterprises
- To create innovation accepting the national strategy in accordance with Thailand Policy 4.0
2.2. Related theoretical concepts

2.2.1. Ozone production method (O₃) in the corona cell set. Corona cell sets will make the air around copper wire is broken down into charge by supplying high voltage direct current to the copper wire which creates a high intensity electric field around the wire surface and when the air passes will cause the air to break down causing ozone gas (This ozone gas is an oxygen gas in the state of 3 atoms. O₃ is caused by the use of high voltage shaking oxygen molecules with the corona discharging method in the state of 2 atoms. O₂ dissolves and merges into 3 oxygen molecules. O₃ will get ozone.)

Ozone can be produced with the following methods
- There are 2 materials or raw materials used to produce ozone.
- Use common dry air.
- Use pure oxygen

2.2.2. Disinfection machine can be separated according to the principle as follows

2.2.2.1. Using electrical principles We call Corona Discharge, which is divided into 2 types according to frequency, namely low frequency type and high frequency type. For hot weather and humid, high frequency type is more suitable because it can produce ozone gas concentration (Concentration) can be higher.

2.2.2.2. Use this type of UV lamp (Ultra Violet: UV) to produce ozone gas. Low concentration will be used in air treatment for water treatment, it is not suitable because the solubility is very low and therefore does not work.

2.3. Research methods

2.3.1. Design and construction of a corona cell set. The corona cell set consists of a pointed electrode placed away from the aluminum grating plate which has opposite voltage. If considering the electric field stress of the corona cell set will follow the equation (1).

\[ E = \frac{V}{d \times \eta} \]  

(1)

When E equal to the electric field intensity
V equal to the voltage
\( d \) equal to the distance between Pointed tip electrodes and Aluminum sieve
\( \eta^* \) equal to the electric field factor.
Therefore, the electrolytic cell set is chosen to use the sharp tip electrodes pointed by placing away from the aluminum sheet (d) equal to 1 centimeter.

2.3.1.1 Calculation of high voltage. Ozone gas production cell set, there is a distance between the sharp tip pointed electrode set and the aluminum grating (d) equal to 1 centimeter and $\eta^*$ equal to 0.2

Therefore, the high voltage is equal to

$$V = E \times d \times \eta^*$$

Therefore, the electric field $= 16.27 \text{ kV/cm}$, Will get $V = 3.254 \text{ kV}$. Therefore, the electric field $E_i = 19.129 \text{ kV/cm}$, Will get $V = 3.825 \text{ kV}$. The voltage area that causes the corona to start is 4.881 kV to 5.738 kV at the electric field 16.27 kV/cm to 19.129 kV/cm.

2.3.2 High voltage power supply design. This research was designed to create a high voltage source switching type has brought the IC number SG3526 to be used in the control circuit in voltage mode. This is a pulse modulator circuit and has a fly back converter circuit. And using high-voltage high-frequency transformers to increase levels.

High pressure which uses switching frequency 20-25 kHz, fixed as shown in Figure 3.

![Figure 3. Block diagram of a high voltage pulsed power supply structure.](image)

3. Results and discussions

3.1 Testing of high voltage signal of fly back transformer as shown in Figure 4

![Figure 4.](image)

(a) High voltage of high frequency switching transformers (Probe x 1000) equal to 1 kV (b) High voltage of flyback transformer (Probe x 1000) equal to 3 kV.
Table 1. High voltage output voltage ozone gas has the ability to disinfect the germ bottle (Which adjusts the frequency 20-25 kHz).

| Output high voltage adjustment | Ozone quantity (ppm) | Enable eliminate diseases in rice germ and packaging room |
|-------------------------------|----------------------|----------------------------------------------------------|
| 1                             | 2.5                  | ×                                                        |
| 2                             | 2.9                  | ×                                                        |
| 3                             | 3.7                  | ✓                                                        |
| 4                             | 4.6                  | ✓                                                        |
| 5                             | 5.5                  | ✓                                                        |

Figure 5. Disinfection apparatus for rice germ and packaging room.

4. Discussion of research results
From the test results, it can be seen that while increasing the voltage level will increase the amount of ozone gas, respectively. This ozone gas can result in the ability to kill bacteria (bacteria) at the nose of the bottle.

5. Summary
In this research, the design and construction of a germinal bottle sterilizer was designed and constructed. With continuous high-voltage pulse corona energy which in the test adjusting the high-voltage output voltage from 1 kV to 5 kV to supply corona cells with an uneven electric field to stimulate electrical energy by using the ripple of high-voltage pulses. To increase the intensity of the electric field then increasing the production rate of ozone gas. In the test results according to Table 1, it can be seen that when the voltage is increased, the amount of ozone gas will increase accordingly. In which the amount of ozone gas, 3.6 PPM, can be used to disinfect the germ bottle packaging at community enterprises as well. According to the results of the tests in Table 1, the amount of bacteria (bacteria) has been used for microbiological analysis which in the future can be further developed in the commercial to respond to the policy of Thailand.

6. References
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