Innovation for Trap Particle and Eliminate Germs in Air By Corona Electrostatic System

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Abstract. This article presents an innovation for trap particle and eliminate germs in air by corona electrostatic system. The air circulation rate is 165 cubic meters per hour by designing the power supply with IC#TL494. The IC#TLP250 uses separate ground and drive Power MOSFET#IRFP460 by bringing DC high voltage from the transformer#TLF14511 to the dust collector unit and the electron separation unit. By designing and building a machine capable of trapping dust particles smaller in size from 0.3 microns up to the results of the tests showed that the dust collecting efficiency of 95.37% from the experiment by measuring the amount of dust using Personal pump and the dust collection efficiency of 95.86% from measuring dust using Handy laser particle counter and part of electron separation can produce corona for producing ozone gas up to 3 ppm to eliminate bacteria in the air. The UV lamps for ozone emissions are reduced to 0.1 ppm for disaster prevention to users.

1. Introduction
In the modern era, there is an increase in air pollution. Which is the effect of various technology development has affected the living conditions and health of the people Therefore, it has invented the method of dust trapping by using high voltage, direct current electricity to reduce air pollution which has been applied by using high voltage switching transformers to produce high voltage to create a dust collector set, where air pollutants are whatever substances are present in the air that affects human health or other living. The air is beings that are undesirable to humans or is a substance that directly or indirectly affects human well-being. There are many types of toxins or contaminants in the air, including dust, odors, smoke, soot and radioactivity, such as carbon monoxide (CO), sulfur oxides (SOX), nitrogen oxides (NOX), hydrocarbons (HC), mercury (Hg), lead (Pb) Radioactive aerosols, etc. These substances, if exceeded in the air, will cause danger to humans, animals and plants. Acute effect can lead to death. Some types can cause chronic poisoning (Chronic Effect) and later death. Toxins may enter the body by contact breathing or indirectly, such as contaminating food with clothing attached and then transmitted into the body for another.

From previous research on dust and cyclone dust collectors for the rice mills of Surin, Ngarmamngam, Sasiwawan Intharakong, Kittisak Chaisuwan, Saran Yu Suksawat, Anawin Kannkaew and Proud Laosong have taken the Abstract: The dust that floats in the air affects the health of living things. Both humans and animals Small particles can penetrate deep into the respiratory system causing inflammation or allergies. This research presents Cyclone and electrostatic dust collectors for rice mills the purpose is to reduce dust in rice mills. Cyclone and Electrostatic Dust Trap Designed to have a rough surface finish panel in order to easily corona increasing the ability to trap dust using DC
voltage is not very high. From the test results by measuring the amount of dust coming out of the cyclone found an average amount of dust of 7.3 mg/m$^3$. The remaining dust will enter the set Trap dust with static electricity when measuring dust at the exit of the electrostatic dust collector, the average dust content is 0.909 mg/m$^3$. From the dust measurement results, it can be seen that cyclone and electrostatic dust collectors can help reduce dust problems droplets in the rice mill down [1].

For research on innovations in dust trapping and airborne germs elimination by using an electrostatic system together with a corona discharge focus on design studies and creating an innovation to trap dust to remove contaminants in the air by focusing on solid parts such as dust, smoke, incense, cigarette smoke and particles between 200 microns and 0.01 microns in size. By creating an electrostatic suite consist of stainless steel plates that are placed at an appropriate distance and alternately feed the positive and negative voltage. To create an electric field between the stainless sheets when various dust and smoke passed through will be captured by stainless steel sheet. And the corona set produces ozone gas for removal of airborne germs With UV lamps to help reduce the amount of ozone gas that is released from the dust trap innovation to the amount of ozone gas suitable for the atmosphere in the room.

2. Equipment and methods
The working principle of the innovation to trap dust and eliminate airborne germs as in the Figure 1. Innovation to trap dust and eliminate airborne germs is to cause the air around the ionized wire to break down into ionizing air (by supplying high voltage direct current to the corona wire) Which will cause the electric field at the surface of the conductor wire to have a high electric field intensity and when the atoms or molecules of the air pass near the wire will cause the air to become ionized.

The dirty air, such as dust, smoke and pollution When passing through the dust trap innovation, this air will circulate through the pre-filter, which filters dust or contaminated particles in the front. From then, this air will be given energy from the high intensity electric field until ionization and the charging of dust to various particles will move to be stuck on a dust collector (Collector Plates) with the opposite electric charge. And air free from dust with UV lamps to reduce the amount of ozone gas to approximately 0.1 ppm for the safety of users, therefore will get clean air free from dust, germs and smells.

![Figure 1](image_url)  
**Figure 1.** The internal structure of the innovation to trap dust and eliminate airborne germs.

In general air, dust, cigarette smoke and other germs are mixed in the air. Therefore, if we pass through the air to be ionized by high voltage circuit dust will be charged and will move to adhere to the set of dust traps. Therefore, making the air we breathe clean Free from dust and germs, improving physical health.
3. The dust trap innovation is divided into 2 major types

3.1. Dust trap innovation by using mechanical principles
This dust trap innovation relies on the use of air filters as filters to remove dust or contaminants from the air by using an exhaust fan is a vacuum that circulates through the air filter. The exhaust fan used must be large in order to overcome the friction or flow resistance of the filter which is high. And the filter used cannot be cleaned.

3.2 Dust trap innovation by using electrical principles
This dust trap innovation relies on air disintegration. (Ionization) and then the dust is charged and then moved to the dust trap. The fan used is smaller than the mechanical type due to the small friction between the dust collectors and the dust collection sheet can be washed and cleaned.

4. Build and design

4.1. Design of an electrostatic system and corona discharge (Electric field cell sets) for trapping dust and producing ozone.
The electrostatic and corona discharge systems consist of a set of stainless steel plates that alternately feed and subtract electric potential. For the dust collection sheet to be used, the thickness should be small in order not to have a strong resistance to the air flow which causes turbulence and will reduce the efficiency of dust trapping. Therefore, the thickness of the stainless steel sheet for dust trapping is set to be equal to 0.09 centimeters. Of the electron separation set and the dust collection set, as in Figure 2.

![Figure 2. Electrostatic and Corona Discharge Kit (Electric field cell sets).](image)

Electrostatic system is a series of electrodes. The uniform electric field means the electrode that has every electric field. The points between them are equal which can be calculated from the relationship.

\[ E_{\text{max}} = E = \frac{V}{d} \]  

Where: 
- \( V \) is the voltage that is fed between the electrodes;  
- \( d \) is the distance between the electrodes;  
- \( E \) is the electric field stress at any point between the electrodes;  
- \( E_{\text{max}} \) is the maximum electric field stress.
Corona Discharge Kit Consists of corona wire placed between stainless steel sheets which has the opposite voltage If considering the electric field stress of the corona set will be according to the equation.

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

Where: 
- \( E \) is the electric field intensity;  
- \( V \) is the high voltage;  
- \( d \) is the distance between the corona wire and stainless steel sheet;  
- \( \eta \) is an electric field factor.

4.2 Design and construction of a high-voltage switching power supply for static and corona discharge charging systems.

Switching high-voltage power supply design introduced the converter circuit principle By using IC No. TL494 as a pulse width modulation generator as a switching control circuit. Which uses mosfet as a device for conducting current which has a switching frequency of approximately 20 kHz. Finally, it will pass through high frequency transformers (Figure 3). To achieve the desired high voltage.

Figure 3. High-voltage DC power supply circuit.
5. Results and criticism of experimental results.

Electric field cell test results with the instrument for analyzing the amount of dust as in Figure 7(a) and the Handy laser particle counter for measuring the dust as in Figure 7(b) tested at a room size of 25 square meters) (testing time 45 minutes)

The test results of measuring dust trapping efficiency with the tools for analyzing the amount of dust, as in Figure 7(a), it is equal to 95.37%.

The test results for measuring dust collection efficiency with the Handy laser particle counter, as shown in Figure 7(b), are equal to 95.86%.

Analyze the test results of dust collection efficiency with an instrument for analyzing dust quantity as shown in Figure 7(a) and Handy laser particle counter for dust measurement as in Figure 7(b). Both types of dust gauges had no different percentage of dust measurement efficiency. (Dust measurement has other components and factors. Get involved may cause the measurement of dust to be inaccurate as well)

The test results measure the amount of ozone that the electric field cells produce (Test time 45 minutes) and the amount of microorganisms before and after using the innovation as in the Figure 4.

![Graph of microbes measured in the air before and after using the innovation to trap dust and eliminate germs in the air.](image1)

**Figure 4.** Graph of microbes measured in the air before and after using the innovation to trap dust and eliminate germs in the air.

![Image of microorganisms before and after using the innovation.](image2)

**Figure 5.** (a) The amount of microbes measured in the air before using the innovation to trap dust and eliminate germs in the air; (b) The amount of microbes measured in the air after using the innovation to trap dust and eliminate germs in the air.
The test result is that the amount of ozone that the electric field cells produce is equal to 3 ppm. The amount of ozone gas is only 0.1 ppm and the amount of microbes in the air before using the innovation to trap dust and eliminate airborne germs is equal to 86.3 colonies and the amount of microbes in the air after using the innovation to trap dust and get rid of airborne pathogens the value of 15.9 colonies. The result of measuring the amount of microbes in the air will find that the amount of microbes in the air after using the innovation to trap SRGB and spray disinfectant in the air has less volume.

6. Conclusion
Innovative dust trapping and air germ elimination by using an electrostatic system together with a corona discharge designed and built electric field cell sets (Electron separator and dust collector set) in which the dust collector plates are placed in parallel by stainless steel plates and feed high voltage DC to create the force of the electric field to collect small dust particles. And the electron separation kit used the corona wire to cause the electric field intensity to produce ozone gas by testing the efficiency of dust trapping using equipment for analyzing the amount of dust, as in Figure 7(a), it is equal to 95.37% and the test of measuring the efficiency of dust collecting with Handy laser particle counter as in Figure 7(b) is equal to 95.86%.

![Figure 6](image1.jpg)

**Figure 6.** Innovation, dust trapping and eliminate airborne germs. By using an electrostatic system together with a corona discharge that has been designed and built.

![Figure 7](image2.jpg)

**Figure 7.** (a) Equipment used to collect dust samples. In order to analyze the amount of dust; (b) Handy laser particle counter for measuring dust.

The ozone produced by the electric field cells is equal to 3 ppm and the results of the measurement of microbes in the air will find that the amount of microbes in the air after using the innovation to trap dust and eliminate germs in the air will be less. And after passing the UV lamp the amount of ozone
gas will be only 0.1 ppm. In the future, this innovation can be further developed commercially in response to and drive the research policy of Thailand as well.

7. References
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