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Research Article

# Design and Manufacture of Virus Sterilization Machine on Packaging to Prevent Transmission of Viruses and Bacteria in the Community

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**Abstract.**
The increasing types of viruses and bacteria such as flu, tuberculosis or even the COVID-19 virus are quite worrying and the potential for this virus to spread is very large through product packaging, so manufacturing of virus and bacteria sterilization machines for product packaging can be a solution. Exposure to ultraviolet (UV) light type C with wavelengths below 260 nm can kill bacteria, viruses, and fungi. This research aims to create a virus and bacteria sterilization machine for packaging. The technology used is using automatic control, electric motor, conveyor, ergonomic frame, and ultraviolet (UV) light type C. This research was done by making design concepts related to machine components, making sterilization tool designs using Autocad software, and making tools to test virus sterilization machines. The creation of this machine can be an effective way to prevent the spread of viruses and bacteria that are carried and attached to the packaging during distribution.

**Keywords:** machine; sterilization; virus; bacteria; packaging; ultraviolet; UV

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## 1. Introduction

There are many types of viruses and bacteria circulating and developing today, including tuberculosis, influenza, herpes virus, Orthopoxvirus, Oncovirus to the corona virus which is currently rumored to continue to mutate into a more dangerous virus. Tuberculosis or Tubercle Bacillus is a common and often deadly infectious disease. The disease is caused by various strains of mycobacteria. These bacteria usually attack the lungs, but sometimes other bodies can also be affected [1].

Coronavirus infection generally causes fever, cough, breathing difficulties and death [2]. The virus is able to spread through many media. One of the main sources of viruses is humans through droplets or

particles produced from coughing or sneezing. In addition, another medium that can even spread the virus widely is product packaging.

Currently, spray-based disinfectants are widely applied in coronavirus prevention efforts. Efforts that are quite popular, especially during the corona virus outbreak, are the use of disinfectants to humans or the environment has the potential to transmit the virus. The use of spray disinfectants has begun to be banned by the Indonesian Ministry of Health, because it is related to health threats to humans, especially the danger to the skin and mucous membranes. Although it can cause danger, the use of disinfectants is also still allowed for use in personal protective equipment (PPE).

In addition, the use of electrolyzed salt water as a disinfectant in the disinfection booth has the basis to produce chlorine as a disinfectant. Ingestion or accidental inhalation may be due to the use of chloroxylenol in sterilization booths. A medical study in Hong Kong on 177 cases of poisoning of commercial antiseptic liquids containing chloroxylenol showed that 7% of patients had serious complications or death [3].

Exposure to ultraviolet (UV) light type C with wavelengths below 260 nm can kill bacteria, viruses, and fungi [4]. In addition, exposure to UV-C light can penetrate into the pores of the packaging material in addition to effectively irradiating the surface of the packaging material.

Ultraviolet (UV) light type C, which is short-wave ultraviolet, has great energy to damage the interaction of protein molecules in viruses [5]. In media containing bacillus sp. bacteria, 38-watt ultraviolet alignment for 1 minute with a distance of 45 cm produced 18 colonies; irradiation for 5 minutes produced l5 colonies; and irradiation for l0 and 15 minutes did not produce colony growth. On the other hand, in the control medium that was not exposed to ultraviolet light, colony growth was very high and could not die [5].

Virucidal-type 254-nm ultraviolet-C light can reduce the survival time of viruses such as SARS-CoV and MERS-CoV. Ultraviolet-C light is also recommended for cleaning masks during a pandemic [6]. In order to overcome the spread of the virus, the author created a virus sterilization machine for product packaging based on the use of ultraviolet-C light as a germicial agent operated by mechatronic devices.

## 2. Material and Methods

The research method used is design and design, literature study and tool making.

### 2.1. Tools and Materials

The tools used in the manufacture of this virus sterilization machine are: electric welding, screwdriver, cutting grinder, hacksaw, hammer, drill and wrench and ring. The materials needed consist of: UV-C lamps from Japan with a wavelength of 256 nm and an electrical power of 15 watts, cables, sockets, plywood, aluminum sheets, nuts and bolts, electric motors, belts, pulleys, aluminum plates and angle iron and control equipment.

### 2.2. Work Procedure for Manufacturing virus sterilization machine

The implementation procedure for making a virus sterilization machine consists of 2 (two) series of work. Stage one, technical design of the virus sterilization machine through working drawings using Autocad software used when making working drawings of the virus sterilization machine prototype Stage two, making a model of a packaged virus sterilization machine.

### 2.3. Design of virus sterilization machine

Making a design using AutoCAD, with a size of 1000 x 500 x 400 mm, including all components used. This size is determined so that the packaging can enter. So that it does not require too long a time for sterilization.

### 2.4. Manufacture of virus sterilization machine

The manufacture of the disinfecting booth starts with the process of cutting iron as a frame. Cutting iron is measured according to the dimensions of each virus sterilization machine frame using hand grinders and saws. After cutting, each part of the chamber frame is painted. Followed by the assembly process to connect the frame using nuts and bolts. After the chamber frame has been finished, a cover is installed as a barrier so that UV light does not come out.

## 3. Result and Discussion

The UV-C disinfection chamber is a room with dimensions (length x width x height) 1000 x 500 x 400 mm. The design of this packaging virus sterilization machine is equipped

with 2 (five) UV-C anti-germ lamps placed at the top. The following are the design details of the UV-C disinfection chamber.

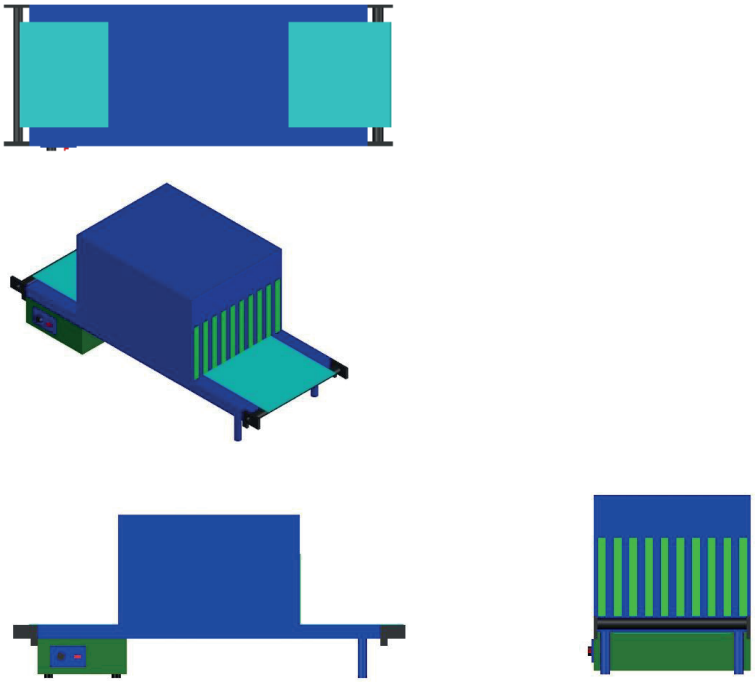

**Figure** 1: view of Virus sterilization machine. Source: Author.

The virus sterilization machine consists of main components such as: iron frame, box pipe and angle iron, wall, roll and UV-C lamp. The design of the UV-C room lamp placement at the top is to provide even UV-C light exposure throughout the room or on the side of the packaging to be sterilized.

The design of the UV-C disinfection room also uses a concept that can be disassembled and installed. This is to facilitate the transportation and transfer process. In addition, the addition of legs aims to facilitate the placement of virus sterilization machines when laying to other areas

1. (a) *Manufacture of virus sterilization machine*

The steps of this virus and bacteria sterilization machine are based on the technical design drawings that have been made. The components of this machine include: conveyor table, control box and electric motor, conveyor and frame. The following are the steps for making a virus sterilization machine

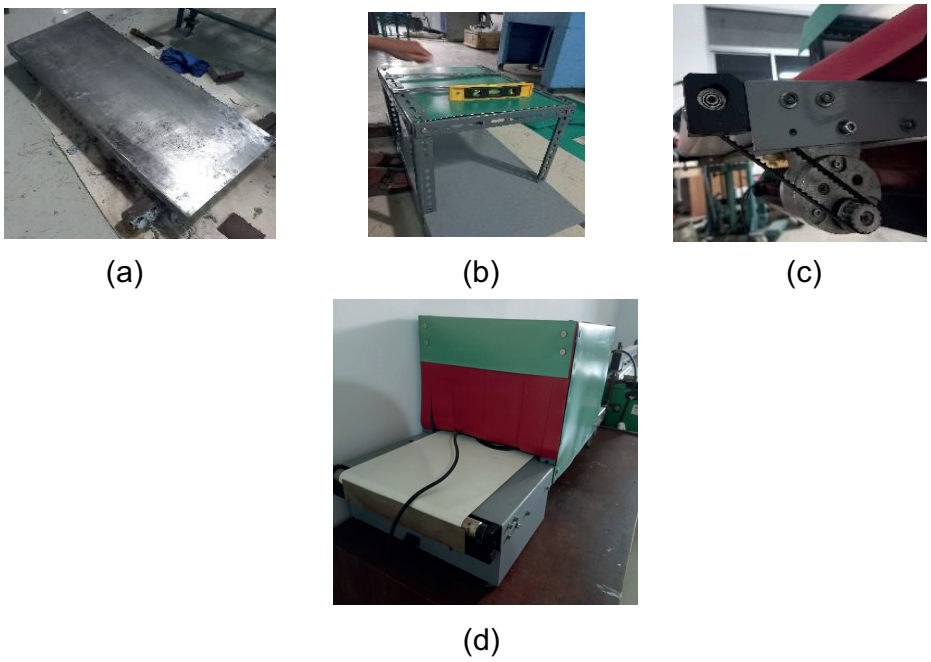


**Figure** 2: (a) manufacturing process Foundation; (b) manufacturing upper frame; (c) Making installation of electric motors and controls; (d) Finished result of virus sterilization machine.

### 3.1. Operation of virus sterilization machine

The operation of this virus sterilization machine is quite easy, after electricity enters the system then press the switch and set the conveyor speed. Turn on the UV-C lamp by pressing the switch. Place the product packaging on the conveyor table and the packaging will automatically be carried into the UV chamber, after the virus and bacteria sterilization process is complete, the packaging will automatically come out.

## 4. Conclusion

Viruses and bacteria are very sensitive to ultraviolet light and heat. Continuous heat at 132.8℉ or about 56℃, 75% alcohol, chlorine-containing disinfectants, preacetic acid, chloroform, and other lipid solvents can inactivate viruses effectively. Exposure to type C ultraviolet (UV) light with a wavelength below 260 nm can kill bacteria, viruses, and fungi [4]. Currently, spray-based disinfectants are widely applied in coronavirus prevention efforts. The use of spray disinfectants has begun to be banned by the Indonesian Ministry of Health, because it is related to health threats to humans, especially the danger to the skin and mucous membranes. UV-C which is short-wave UV has great energy to damage protein molecular interactions in viruses [5]. Therefore, the author

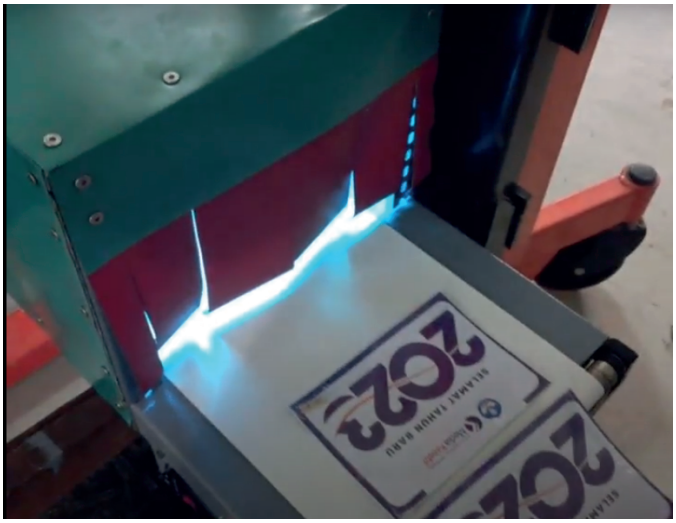

**Figure** 3: Finished result of virus sterilization machine. Source: Author.

uses UV-C light as a method of sterilizing viruses and bacteria in this virus sterilization machine. The existing sterilization equipment includes: conveyor table, sterilization chamber, UV-C lamp, electric motor and control. By using automatic control and drive this machine can operate effectively and is able to kill viruses and bacteria attached to the packaging.

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