

Mini Incinerator for Environmentally Trash Processing to Support ITS Eco Green Campus

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Abstract: Trash is the residue of daily human activities in solid form and has the potential to cause health hazards and hygiene sanitation. Trash is also of the major problems in big cities. Trash has negative impact on the environment, because trash can cause environmental pollution. To reduce combustible trash that can no longer be recycled and toxic chemicals, solid trash must be burned at temperatures higher than 800°C to minimize combustible and non-recyclable trash. Incineration is one of the many steps ITS has taken to fulfill its responsibility as an organization that values conservation. Because it produces little emissions, incinerating trash is one of the environmentally friendly methods of wasting management. The main burner and primary chamber, the two main parts of this incinerator machine, using used oil and water as fuel. The wet scrubber was built to covert smoke into the liquid one that have economically value. Incinerator technology is easy to use, safe to operate, and capable of destroying trash through high-temperature burning. The residue produced from the process is also safe for the environment. Using used oil and water as fuel, the incinerator has been tested and found to be functional. It takes about an hour to test this tool's ability to burn 100 kg of solid trash. As a result, the working temperature rose to 800 °C and trash was successfully converted to ash. In order to support the ITS Eco Green Campus, this machine can be used as a small-scale solid trash processing tool.

Keywords: alternative technology, combustion chamber, environmental trash handling, trash management.

1. Introduction

Trash is a serious problem that is being faced by humans. This is because not all trash can be decomposed quickly, some even take hundreds of years to be destroyed. Meanwhile, the amount of trash continues to grow every day, so there is an imbalance between growth and decomposition. If trash is left unattended, it will have a negative impact on human health as well as the sustainability of the environment. According to the World Health Organization (WHO) trash is something that is not used, not liked or something that is discarded that comes from human activities and does not occur by itself [1]-[4]. Based on Trash Management Law Number 18 of 2008, trash management includes trash reduction and handling. If trash management is not carried out systematically, thoroughly, and continuously, it will have various negative impacts, both on health, the environment, and the socio-economy [5].

One location that has the potential to generate a lot of trash

is a campus. There are three types of garbage produced: non-recyclable, recyclable, and organic. According to [6], organic trash is generated by staff and student food trash, leftover food from canteens or food stands, and plant and grass debris from campus parks and green areas. Given the abundance of trees around the Department of Biology ITS, one of the hubs of educational activity, the Department of Biology ITS generates trash from food consumption, cafeteria operations, teaching and learning activities, and organic trash like leaves. Due to the volume of trash produced, there is a buildup of trash in the increasingly small trash storage area [7].

One of the more useful and alternate methods of treating garbage is the combustion process. This system has benefits in addition to generate thermal energy and have a shorter degradation period than open dumping, landfills, and composting. The combustion process can reduce trash volume by up to 90% while composting, landfill and open dumping can only reduce the volume by 40% [8]. Incineration according to [9], [10], is a solid trash treatment process by burning trash at a temperature of more than 800°C to reduce combustible trash that cannot be recycled. According to [11], incineration technology is a tried-and-true method for handling a variety of trash types and doesn't require a lot of land. The technology of incineration has been employed to handle municipal trash in many developed nations.

An incinerator is a machine that burns trash solids at a specific temperature by using combustion technology. With the help of this technology, garbage piles may be reduced while producing ash and liquid smoke that can be used as organic insecticides and fertilizers that are both profitable and good for the environment. This technique aims to cut down on the amount of trash that is disposed of in bulk [12]. Incinerator technology is one of the trash destruction instruments with the least negative environmental effects, easy maintenance, and safe operation because of the emissions it produces. The components of the mini-incinerator are as follows [13]:

- a) The primary chamber, which houses the steel plate primary burner or plasma burner.
- b) The conversion of smoke from a steel barrel with a blower and cyclone system into liquid smoke

Therefore, the goal of this project is to create a small, environmentally friendly incinerator that can reduce the amount

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of trash produced by the Biology Department's teaching and learning activities, organic trash from falling leaves, and the cafeteria. Plants can benefit from the ash and liquid smoke produced as bioproducts.

2. Material and Methods

A. Manufacturing process's Flowchart

The flow chart in Figure 1 below can be used to demonstrate the incinerator manufacturing process:

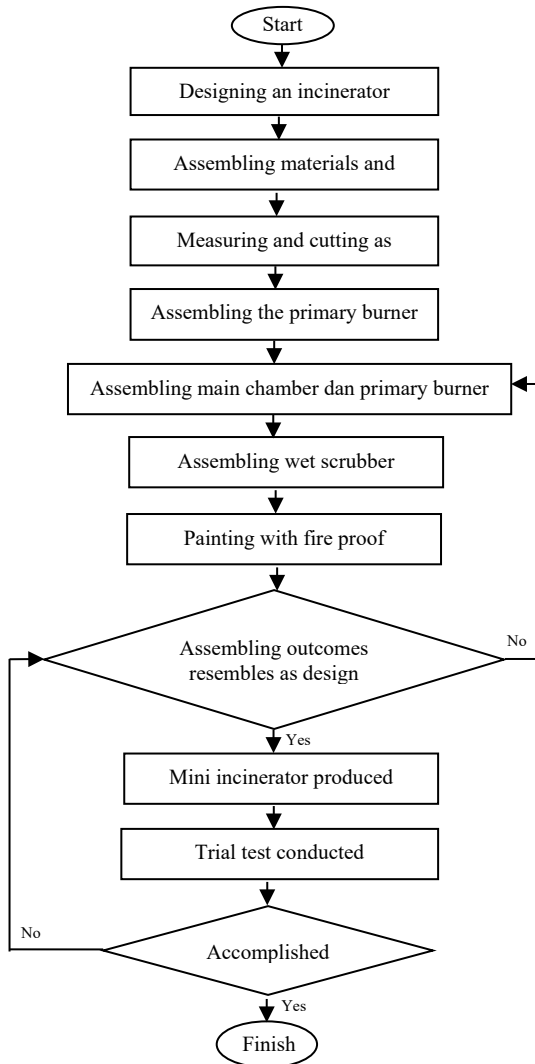


Fig. 1. Incinerator manufacturing flowchart

B. Equipment's and Materials

The following equipment's are used in the production of the incinerator: grinder, electric drill, electric welding, rollers ruler, hammer, and compressor. While the materials used for the manufacture of this mini-incinerator machine include glass wool, paint, thermogun, 12mm iron pipes, 3mm iron pipes, 2mm sheet iron, iron barrels, heat-resistant pipes, anti-rust paint, iron glue, concrete buses, welding wire, suction blowers, bearings, flexible pipes, electric pumps, anti-fire paint, 3-4 mm aluminum plates, and organic and inorganic trash. The research was conducted at the Department of Biology, FSAD ITS and

the Department of Materials and Metallurgy FTIRS from May to November 2023.

C. Trial Test Procedures

Trial test on mini-incinerators was conducted by burning organic and inorganic trash. The burning time is approximately 70 minutes or until it produces ash completely. During the combustion process, a thermogun was used to check the temperature. The following is a flowchart of the incinerator trial procedure:

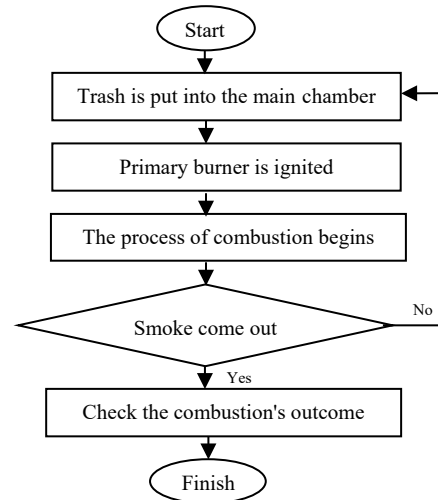


Fig. 2. Incinerator trial test flowchart

3. Results and Discussion

University trash management should be able to innovate in order to manage trash well without harming the environment [14]. Biology department as a part of the university has a responsibility develop the values and character of conservation. The initiatives undertaken by Biology Department is trash management in small scope by using incinerator machine system. The Fig. 3 describe the incinerator's design that will be made for this research.

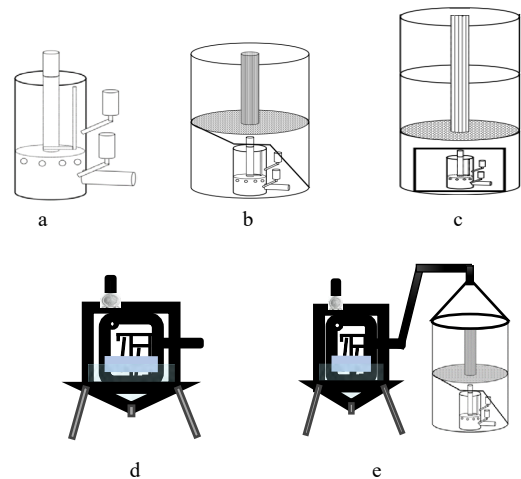


Fig. 3. Incinerator's design

a. Primary chamber; b and c. Primary burner; d. Wet Scrubber; e. Incinerator

A solid trash incinerator with the following specifications was obtained from the incinerator manufacturing process:

- a. Combustion chamber tube which diameter 580 mm x 900 mm
- b. Chimney, which diameter 400 mm x 400 mm, made of plate material 1,2 mm, wall coated with fiber blanket (ceramic wool) fire resistance 1250 degrees, with ash removal (150 mm x 400 mm)
- c. Wet scrubber tube which diameter 300 mm x 530 mm, 1,2 mm galvanized plate with inner baffle component, 300 mm diameter suction blower, ½ pk ac motor drive, 1phase, and 6 fan blades
- d. Carts and wheels, 1200 mm x 800 mm, with 4x4 angle iron with 1,2 mm plate, and 3 inc wheels
- e. Suhu: 600-800°C (dalam ruang pembakaran)
- f. Bahan bakar: oli bekas 1 liter, air (steam generator) 2 liters, and air (pengubah asap) 5 liters.
- g. Daya listrik: 400 watts/1phase (electric motor)
- h. Working time for one refueling: 1 hour 10 minutes
- i. Combustion time required for 100 kg of trash: 1 hour
- j. Pre heating time (warming up the water oil stove): 30 minutes

In the incinerator, the isolator plays a critical role. Glass wool is used in this isolator, in order to prevent hot room temperature heat from directly transferring through the incinerator casing and into the outside. This incinerator's casing is made of 2 mm thick iron plate. The casing acts as a chamber holder to keep the chamber from being easily damaged and shields the insulator and chamber wall from outside air. The chimney is the most crucial component in the incinerator for removing air from the chamber. This incinerator is constructed with pipes that have a diameter of 400 mm, a thickness of 1,2 mm, and coated with fiber blanket. The incinerator's bodies were painted. The purpose of this painting is to enhance appearance and prevent corrosion to the material.

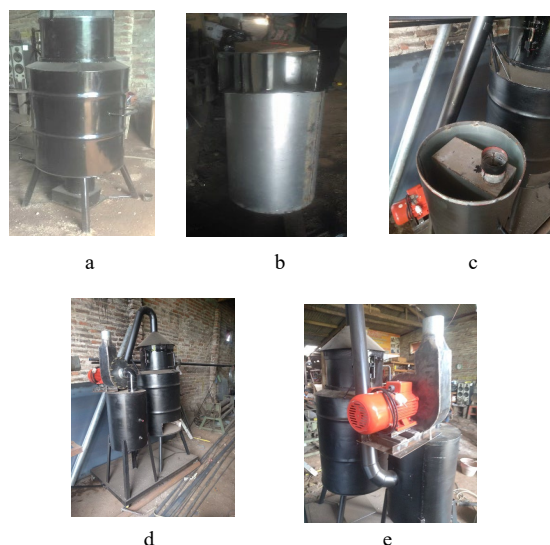


Fig. 4. Incinerator's design

- a. Primary burner; b and c. Wet Scrubber; d and e. Mini Incinerator

From the trial test results the temperature of this equipment is able to reach a temperature of 900°C and can be operated to process solid trash burned to ash except trash made from glass and steel. Chamber wall checking applied to check the physical

condition of the steel after a long time of operation. Maintenance on this equipment components can be done routinely by operators after used, such as cleaning of dirt from combustion residues solid trash after the operation



Fig. 5. Trash burning process

4. Conclusion

The incinerator machine system that has been made, is capable to processing solid trash into ash except glass and steel with a temperature reaches 900°C with a capacity of 100 kg trash for 1 hour.

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