
Design of Hybrid Smokeless Waste Burners Machine for Producing Organic Fertilizer

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Abstract

The number of waste problems in Karawang are increasing, but the handling is still limited. The Karawang society produces 920 tons of garbage everyday. Of the number, 400 tons of waste is sent to TPSA in Jalupang. While 520 tons of the rest garbage is scattered everywhere. Overcoming the waste problem, it is necessary to have an environmentally friendly tool for direct burning of waste that can not be recycled again. Hybrid Smokeless Waste Burners Machine (HSWBM) is an environmentally friendly technology by burning smokeless waste through smoke filtering using water or water scrubbers. It also using Hybrid technology which is utilize electricity independently from solar panels or electricity from power plant. The method used is the design of tools, and component assembly. The advantage of HSWBM is eco-friendly because it uses water as smoke and hazardous gas filtration so that the discharged gas is more clean. The electricity is independent from solar panels thus saving the operational costs of the tool. The remaining combustion gas or ash can be used as organic fertilizer or briquettes. The deposition of smoke in water (aerosols) can be used to fertilize agricultural crops and reduce waste in Karawang. The HSWBM can be applied on a limited scale such as in schools, campuses and houses in Karawang.

Keywords: waste; HSWBM; hybrid technology; water scrubbe; organic fertilizer

1. INTRODUCTION

There is a dangerous problem of waste in Karawang because of its increasing amount, but the handling is still limited (1). Everyday, the Karawang community produces 920 tons of garbage. Of this amount, 400 tons of waste is sent to TPSA in Jalupang, while 520 tons of the remaining waste is scattered everywhere (2). Waste management can be done by reusing it such as for handicrafts. However, waste that is not able to be reused is generally burned which can cause air pollution. In fact, combustion of waste to reduce the volume of accumulation can be transformed into a process that is friendly to the environment and at the same time makes combustion products can be utilized.

One of the technique for waste management is by burning waste or utilizing it as fuel in steam and electricity generating units. The equipment or waste combustion units are called incinerator. There are two types of incinerator based on their utilization. Both are used as waste destruction by disposing heat rise from burning and utilizing heat rise from burning waste to be converted to electricity or steam production (3). Hybrid Smokeless Waste Burners Machine (HSWBM) is a technology by burning smokeless waste through smoke filtering using water or water scrubbers and using Hybrid technology by using electricity independently from solar panels and electricity from power plant which is only used when the weather is cloudy. HSWBM is limited to burn the waste without utilizing heat into electricity because it is limited scale that can be applied in schools, campuses and houses in the city.

2. METHODS

The method used in making Hybrid Smokeless Waste Burners Machine (HSWBM) is applying three-dimensional machine design drawing in Inventor software. This design includes the overall design of the machine, the design of the main machine components, and the design of the technology used in the engine. The purpose of each step is make sure that the drawing design of HSWBM has less error. The second, each parts need to assembled.

2.1 Design Drawings of HSWBM

Comprehensive design drawings for machine can be seen in the figure below:

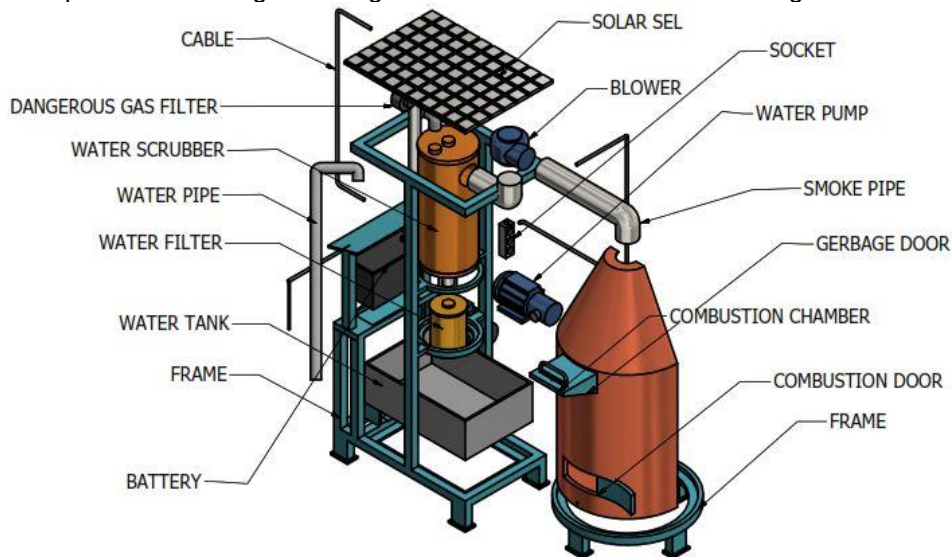


Figure 1. Comprehensive design drawings for HSWBM

Figure 1 shows the overall design of HSWBM which has dimensions of length x width x height is around 2000 mm x 600 mm x 1200 mm. This tool scale is not too large in dimensions. The design has the main components in addition to the supporting components as in the Figure 1, such as incinerator furnace, water scrubber, hybrid electricity source, dangerous gas filtration and water, pumps and blowers. HSWBM is designed by uniting or assembly the components so that they become one complete chain. And the technology used is water scrubber, hybrid technology for electricity sources from solar panels and PLN and membrane filtration technology in smoke exhaust and water circulation.

The material used is iron on the tool frame, furnace, smoke pipe, PVC pipe material for drains, smoke filtering, plastic material for water storage tanks. Material is chosen by considering the properties and strength of the material as used or the function of the HSWBM tool.

2.2 Drawing Design of the Main Components of HSWBM

The design drawings of the main components are divided into four parts. The first is combustion furnace or incinerator, shown in Figure 2. It burn the waste to transferred the ash to smoke inlet. The second is smoke inlet, shown in Figure 3. Its function is to flow the smoke from incinerator to water scrubber. The third is smoke filter or water scrubber presented in Figure 4, which serves to filter smoke with water. The fourth is electricity source using hybrid technology (Figure 5). Its functions is to be the independent power source through solar panels and electricity from power plant if weather conditions do not support solar panel.

Combustion furnace (*incinerator*)

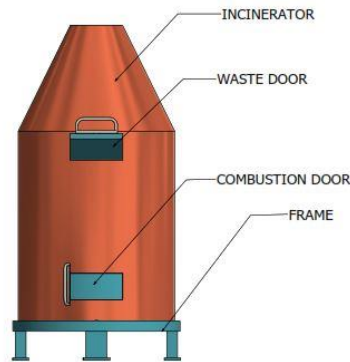


Figure 2. Incinerator

Smoke inlet

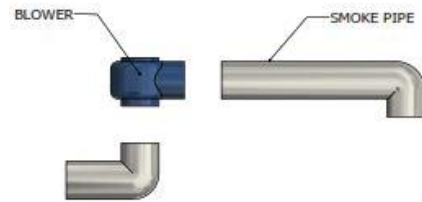


Figure 3. Smoke inlet

Water scrubber

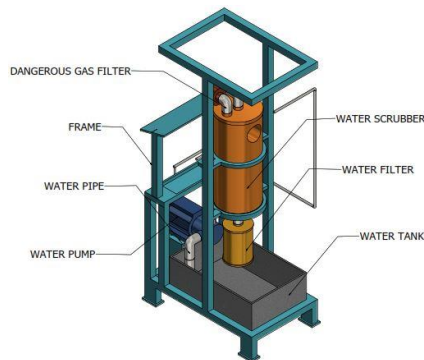


Figure 4. Water scrubber

Hybrid technology

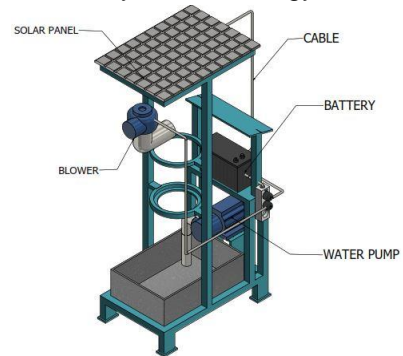


Figure 5. Hybrid technology

2.3 The Technology Design Used Is HSWBM

There are three type of technology design used in this research. The first is water scrubber technology, secondly is hybrid technology, and the third is filter water and dangerous gas technology.

2.3.1 Water Scrubber Technology

Water scrubber technology design drawings can be seen in the Figure 6:

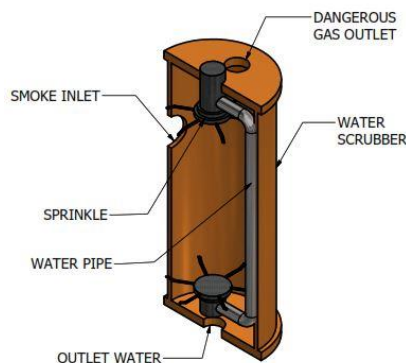


Figure 6. Water scrubber technology design

From the Figure 6, water scrubber technology is used to filter smoke using water. When the combustion fumes flowing into the smoke filter, 2 sprinkle rotors will spray water from above and below. Then the smoke condensed by water. It causes the water to become dirty due to it catches smoke particles (aerosols), furthermore, it also make the color

becomes blackish yellow. Therefore, this technology makes the smoke coming out of the exhaust channel freshly so that it becomes environmentally friendly.

2.3.2 Hybrid Technology

Hybrid technology design drawings can be seen in the Figure 7:

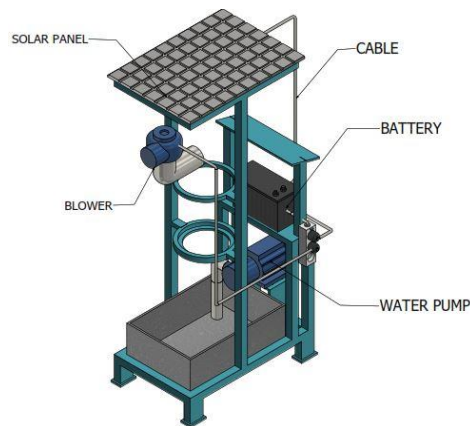


Figure 7. Hybrid technology design

From the Figure 7, hybrid technology is used as an electricity source to ignite blower and pump. The main electricity source is obtained from solar panels and second from PLN electricity. When the solar panels are exposed to the sun's heat, the heat is converted to electricity, then the electricity is stored in batteries. In addition, PLN's electricity sources can be directly connected to pumps and blowers. However, PLN electricity is used when weather conditions are not possible. Therefore, this technology will save operational costs from the electricity used.

2.3.3 Filter Water and Dangerous Gas Technology

Filter water and dangerous gas technology design drawings can be seen in the Figure 8:

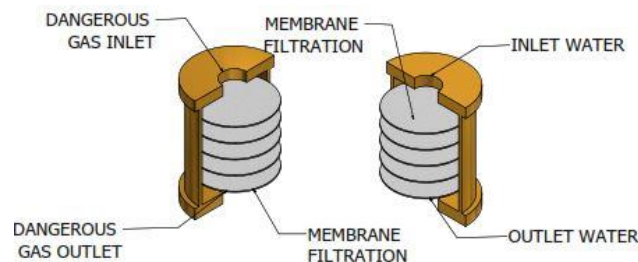


Figure 8. Filter water and dangerous gas technology design

From the Figure 8, membrane filtration technology is used to filter or filter out the smoke coming out of the exhaust channel in filtering the smoke so that the level of dangerous gas decreases. Next to filter the circulating water after the water mixed with aerosols. So that the water becomes clean again and saves water used. Therefore, this technology makes the levels of dangerous gas decrease and circulating water becomes efficient and these aerosols can be used to mix fertilizers and pesticides in agricultural crops.

3. RESULT AND DISCUSSION

HSWBM manufacturing process through frame wrapping by welding process. After the framing process is finish, all the main and supporting components are assembled. Then, the HSWBM tool is complete and ready to use.



Figure 9. HSWBM machine

3.1 The Working Principle of HSWBM

The flow chart of the working process of the HSWBM can be seen in the figure below:

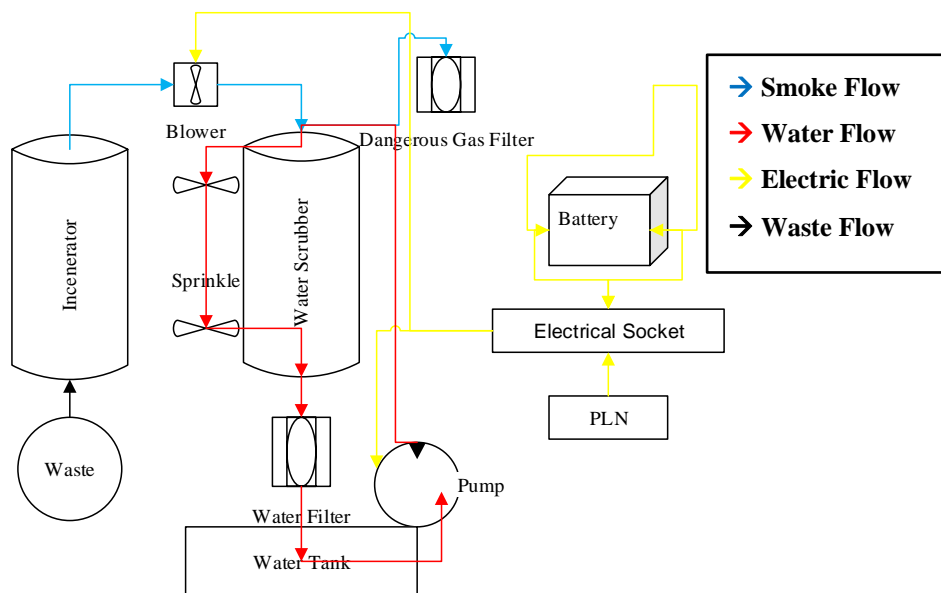


Figure 10. The flow chart of the working process of the HSWBM

From the Figure 10, the first work process of HSWBM is from the black line. The waste enter the furnace as the fuel of the combustion process. The second blue line means the combustion smoke flow from the furnace inhaled into the filter and comes out from gas filter. The third red line means that the water from the tube is pumped up into the spray or rotary sprinkle. Then, the water condenses the smoke that it becomes dirty. The 4 yellow lines mean electricity from the solar panel to the battery. Furthermore, the electrical socket flow from the socket to the blower and pump. If you use electricity from power plant, it flows to the socket and continued to the blower and pump.

3.2 HSWBM Machine Components

Important components of the HSWBM include.

3.2.1 Frame

The frame functions is to support all HSWBM components, shown in Figure 11.



Figure 11. Frame of HSWBM

3.2.2 Incinerator

The incinerator used to burn waste shown in Figure 12.



Figure 12. Incinerator

3.2.3 Solar Panel

The solar panel functions is to convert solar thermal energy into electricity. The solar panels used in this research are 3 units with a total 50WP.



Figure 13. Solar panel

3.2.4 Battery

The battery store electricity from solar panels. The battery with 12V 45AH specification can be seen in Figure 14.



Figure 14. Battery

3.2.5 Controller

The controller function is to regulate the amount of electric current from the solar panel to the battery (Figure 15).



Figure 15. Controller

3.2.6 Sprinkle

The sprinkle spray water into the smoke of combustion in the water scrubber, shown in Figure 16.



Figure 16. Sprinkle

3.2.7 Pump

The pump flowing water into the water scrubber shown in Figure 17.



Figure 17. Pump

3.2.8 Blower

The blower function is to suck the burning smoke inside the incinerator, presented in Figure 18.



Figure 18. Blower

3.2.9 Water Filter

This equipment filter the water from filtering smoke from the water scrubber to the water tank to clean it again (Figure 19).



Figure 19. Water filter

3.2.10 Gas Filter

Gas filters as shown in Figure 20 has the function to reduce the levels of dangerous gas from combustion before going outside the environment.



Figure 20. Gas filter

3.2.11 Water Tank

Water tank function is to save clean water, can be seen in Figure 21.



Figure 21. Water tank

3.2.12 Panel Box

Panel box (Figure 22) has the function to save batteries and controllers.



Figure 22. Panel box

4. CONCLUSION

The HSWBM has been designed in this research. Its main function is to burn the waste become smokeless with a limited scale. In addition, hybrid technology can be functioned as a source of electrical energy to drive pump and blower by utilizing solar thermal energy which is converted into electricity through solar panels. Combustion smoke can be cleaned with water scrubber technology where is spraying water from sprinkles filter to entire region that smoke is flowed. Small particles (aerosols) and ash fly are carried by water and enter the water filter. The dirty water is filtered as it can be used again to carry the smoke particle. Gas filters can reduce the levels of harmful gases from the combustion of waste so that it becomes environmentally friendly and smoke does not go out into the environment.

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