

Smart Waste Collector

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Abstract : Nowadays, the development of the restaurant industry in Malaysia affects the generation of food waste or organic waste. If the production of this food waste is increasing and is not well-managed, it will cause the garbage thrown into landfills to increase. The food is still ending up in Malaysia's landfills, and space is running out. Smart Waste Collector is a machine that functions to destroy food waste safely without the need to throw it directly into the trash can. This is because the continued disposal of food waste into the garbage will produce an unpleasant odor, especially for users who live in a hostile atmosphere that is large and does not have an effective waste disposal system. The leftovers will be crushed using rotating machine blades, and the crushed residue will collect at the bottom of the machine. In this study, the model of the Smart Waste Collector was fabricated to demonstrate the working principle to destroy food waste effectively.

Keywords: Food Waste, Smart Waste Collector, Compost Fertilizer

1. Introduction

Food waste is discarded daily due to the living nature of human beings via agricultural, industrial, and domestic activities. Generally, food waste sources can be sorted into three groups: food losses, food materials lost during preparation, processing, and production phases in the food supply chain, unavoidable food waste, and the inedible parts of food materials lost during consumption [1]. Food waste disposal is categorized as the disposal of solid waste under the Malaysia Solid Waste and Public Cleansing Management Act 2007 (Act 672). It can be any method from destruction, incineration,

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deposit, or decomposing [2]. Landfill and incineration are the more common methods for food waste disposal. The landfill is a generally accepted method for managing food waste as it is cost-effective and simple. However, food waste management via landfills has become more difficult as many landfills have reached their capacity in Malaysia [3]. **Figure 1** and **Figure 2** show the reality of food waste disposal in the community.



Figure 1: The way how food waste is treated **Figure 2: The better way to treat the food waste**

Smart Waste Collector is a machine that securely destroys food waste instead of throwing it directly into the trash can. This is because the prolonged disposal of food waste into the garbage would develop an unpleasant odor, particularly for users who live in a polluted environment with a huge waste disposal system. From **Figure 3**, the leftovers will be crushed by revolving machine blades, and the crushed residue will accumulate at the machine's bottom. A drawer is provided for customers to properly dispose of damaged food waste and employ materials that are easy to clean with mere water. The top room is covered using plate beams for the safety system rather than engine blades and the cleanliness of the machine's outside surface. The upper part system that users may open will make it easier to handle the machine if difficulties arise on the inside or to assist in cleaning activities.

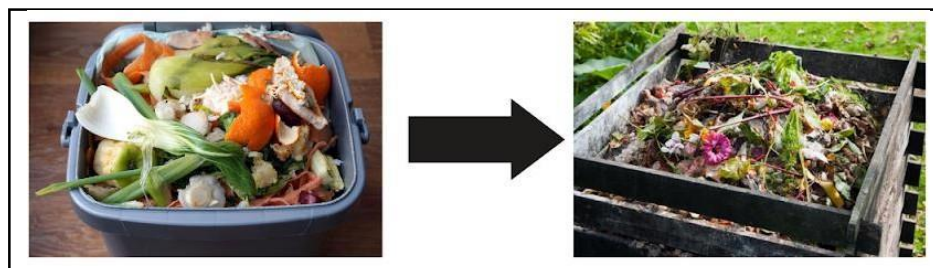


Figure 3: The food waste turned into small pieces

There have been machines in Malaysia that serve to remove leftover waste, however, many people are unconcerned about technical improvements. As a result, the technologies contained in smart waste collectors might make it simpler for housewives or working people to have a more efficient food disposal system in their households. A higher improvement, on the other hand, will certainly please the user's heart.

2. Materials, Methods and Product Testing

The selection of materials and the fabrication process of the project were made carefully so that the desired results met the specifications. Then, the product will be tested to evaluate its functionality.

2.1 Materials

Material selection is an essential aspect of product design and development. An appropriate material should meet many basic criteria including efficient manufacturability, performance, reliability non-degradability and recyclability.

Table 1: Characteristic and Mechanical Properties of Material for Each Component [4]

Component	Materials	Mechanical Properties of Material
Body Machine	Mild Steel	<ul style="list-style-type: none"> • Weldable • Ductile • Yield strength, 250 MPa • Ultimate tensile strength, 500 MPa
Drawer	Mild Steel	<ul style="list-style-type: none"> • Weldable • Ductile • Yield strength, 250 MPa • Ultimate tensile strength, 500 MPa
Cover	Mild Steel	<ul style="list-style-type: none"> • Weldable • Ductile • Yield strength, 250 MPa • Ultimate tensile strength, 500 MPa
Curve Section	Mild Steel	<ul style="list-style-type: none"> • Weldable • Ductile • Yield strength, 250 MPa • Ultimate tensile strength, 500 MPa
Blade	Stainless Steel	<ul style="list-style-type: none"> • Corrosion resistance • High tensile strength, 290 MPa • Durable • Low maintenances

Table 1 stated all the materials that had been used in making each part of the component. The body machine, drawer, cover, and curve section are using mild steel because it is easy to weld to join for each part during the fabrication process. It had been chosen because of the ductility so that it can be molded into highly precise forms, making it ideal for use in shaping. Mild steel is suitable for use on smart waste collectors because the high yield strength of the iron sheet can accommodate the strength of the machine when the machine is operating.

Although mild steel sheets have a high mass, the nature of the smart waste collector that does not need to be moved from one place to another precisely helps to prevent the machine from shifting position due to vibrations that occur while the machine is operating. The amount of ultimate tensile strength for mild steel is 500 MPa. For the blade, the material that was chosen is stainless steel. It has a good corrosion resistance which helps to extend the life of the blade and its efficiency. Other than that, stainless steel has a high tensile strength of 290 MPa. In terms of sharpness and edge retention, stainless steel can keep a sharp blade for an extended period. This steel is also less rigid and more flexible than carbon steel, allowing it to absorb blows more efficiently without breaking or splitting [5].

2.2 Methods

The fabrication of the Smart Waste Collector needs to follow the required process and fabrication for the project testing. The main purpose of making this machine is to prove the ability of this machine can work to break down large chunks of food waste into smaller chunks. The process involved in this machine is decomposing. However, the type of cutting blade used is not suitable for the test material and the amount of power available to the motor and battery used is not able to accommodate to rotate the cutting blade more effectively.

Therefore, the food waste will be converted into a lighter and softer object so that it can overcome the problem that occurs. If the object can be cut by between 30-50%, this means that the machine has succeeded in achieving the desired objective [6]. All parts of the machine components are divided into several sections shown in **Figure 4** below.

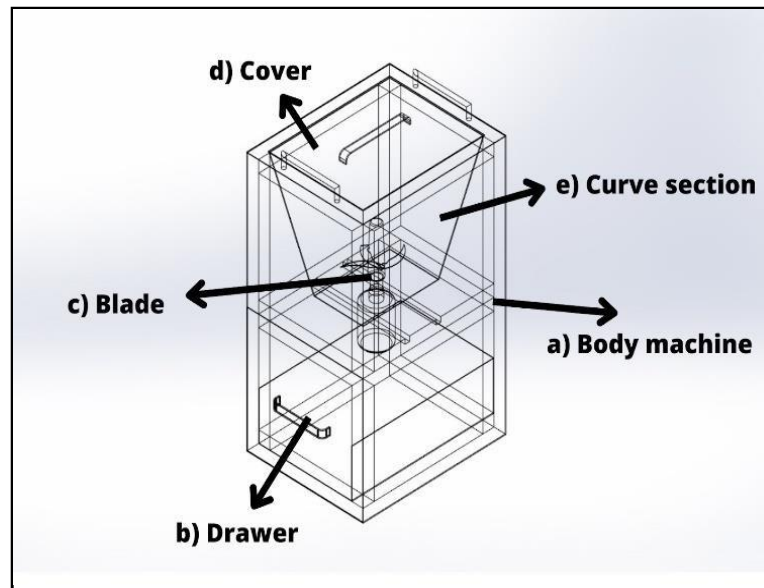


Figure 4: Each component of the machine

To run this machine, make sure the machine is in open switch state. Open the cover, then when the cutting blade already rotates, food waste will be inserted into the curve section space for the cutting process. Food waste that passes through the space will be cut into small pieces when it hits the cutting blade. Then, the leftover food that has been cut will fall on the part of drawer located at the bottom of the machine. When all the food waste has been cut, the switch on the machine will close and the blades will stop rotating. Drawer will be pulled to make it easier for users to dispose of food waste that has accumulated in the section.

2.3 Product Testing

Product testing is the process of evaluating and assessing products to ensure that they meet the necessary safety and quality standards. Here are the tests involved in this project.

2.3.1 Test 1

Load testing is used to assess the performance of applications and environments under typical and excessive load conditions. They are intended to establish the maximum amount of demand that an application can handle, and a good load test will reveal bottlenecks and weak points in the code that might lead it to buckle in the face of a sudden increase in traffic. Load and performance testing is used to examine software by applying it to changing amounts of load and measuring its performance under various load circumstances.

Procedures:

1. Put the waste into the machine starting with the lightest load which is 100 g until 500 g .
2. Took the time for each load of waste to finish the process.
3. Check the body, miller condition, and motor condition if there is any problem with different loads.
4. The suitable load with no damage to the machine or effect on the rotation of the miller is chosen as the estimated load for the machine.

2.3.2 Test 2

The time taken to finish the process with the highest load needs to be tested because the user will need to estimate the time taken to process the waste. If the time taken to process 100 g of waste took a long time, the product needs to be improved to have short processing.

Procedures:

1. Using the largest load based on the first test, put the waste into the machine then take the time to finish the process.
2. Repeat the same process with the same amount to make sure the machine works under the same conditions.
3. The improvement is needed if the time taken to finish the process is too long than how it should work.

3. Results and Discussion

The purpose of the discussion section is to interpret and describe the significance of the findings in relation to the result obtained. A clear working principle will make it easier for users to operate the machine.

3.1 Working Principle of Smart Waste Collector

Figure 5 shows the Smart Waste Collector model. **Figure 5(a)** shows the switch that needs to be turned on when using the machine. The switch will allow the electric current to flow to move the blade. **Figure 5(b)** shows the blade that is used to cut the large size of waste into smaller pieces when the switch is turned on. Lastly, **Figure 5(c)** shows the drawer that will be used to take out the food waste that has been stored inside the Smart Waste Collector.

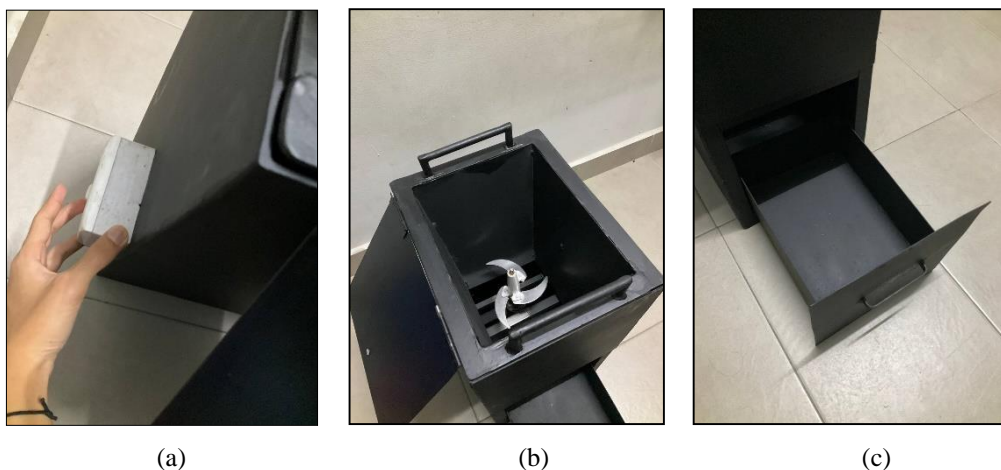


Figure 5: Working principle, (a) switch on, (b) rotating blade, (c) food waste container

3.2 Functionality of Smart Waste Collector

Based on the testing that has been done, the waste material that has been put into the central part of the machine containing the blade will cut the food waste that has a larger size into a smaller size. Theoretically, all components in the waste material will be ground together until wholly destroyed hugely but after testing is done, the result is not the same. The product efficiency for cutting the waste material into smaller pieces depends on the size of the waste as shown in **Figure 6**. The product efficiency is quite low due to the speed of the blade not being fast enough. It is because the power supply that supplies the power to the motor is quite low which is 12 V. After having tested the motor and it can withstand the volt around (16 - 20) V but it does not last long. The motor will overheat if the power supply is above 12 V. Therefore, for safety purposes, the product will continue the supply of 12 V to avoid any injuries that may occur during the testing of the product and when using it.



Figure 6(a): Input



Figure 6(b): Output

4. Conclusion

Smart Waste Collector can make it easier and more convenient to collect food waste. It helps in the breakdown of 50% of food waste, facilitating the production of composite fertilizer. This Smart Waste Collector is also effective in collecting food waste, whether it is dry or wet. When food collects, this Smart Waste Collector will not generate a nasty smell. This is because this instrument is airtight so that it does not generate a foul and unpleasant smell. However, certain things need to fix so that this machine will be able to perform for a long time. It is suggested that a bigger motor and a higher voltage power source be used so that food waste may be broken down more easily. Change the material on the machine's wall to something lighter.

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