

Design and Development of Organic Material Shredder Machine Rotary Blades Model

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Abstract: This design to make the organic materials crusher machine which its structure can be made easy and cheap by society, and can be operated simply, moved by gasoline engine 6.5 hp own the ability can can break the permanent organic materials upon which compost. This activity divisible in 2 solution framework that is technical solution framework and solution non technical. Technical Approach: approach to society of orchard Dasri by attending method/machine to processes and dissociate the garbage type so that heaping sum up the deductible garbage. Approach of non technical: approach to citizen by guiding and growing to develop the society awareness about its important keep cleaning environmental and sanitation.

From final this activity inferential that: making of organic materials crusher machine earn the especial problems faced by group society orchard of town Banyuwangi - Indonesia. Making of enforceable organic materials. Machine better as according to time plan which have been determined, Especial problems partner concerning garbage processing with this machine attendance expected depending to on duty deductible town Tegalsari hygiene and created society of self manage garbage. Result from this garbage processing machine in the form organic materials upon which compost of the size 2-3 cm and organic materials process become the compost used by farmer group, so that indirectly can improve the earnings of society of orchard Dasri and permeating new labour.

Keywords: crusher, organic materials and compost.

Introduction

Currently, most of the waste is generated as a result of human activities. The existence of changes in lifestyle in consuming food and the lack of public awareness of environmental hygiene causes an increase in the amount and type of waste. Based on the chemical content, waste is divided into two groups, namely inorganic waste which generally takes a very long time to decompose and organic waste which requires relatively fast decomposition time. Sometimes we don't realize that there are so many organic wastes. Even though it is easy to decompose, this waste still has a more useful value than being burned which will only produce pollutants for the air. For example, processing waste into organic fertilizer. Compost is a natural (organic) fertilizer made from forage materials and other organic materials that are intentionally added to accelerate the decomposition process, such as livestock manure or if deemed necessary, factory-made fertilizers, such as urea, can be added [1]. Compost has several beneficial properties, namely improving the structure of loamy soil so that it becomes lighter, increasing the binding capacity of sandy soil so that the soil does not crumble, etc. By processing waste into organic fertilizer, it will reduce the negative impact of pesticides in the agricultural sector [2].

Waste processing for the purpose of making organic fertilizers can be done simply. Garbage in the form of leaves, small twigs, kitchen waste and livestock manure is put into the garbage chopper machine so that the size of the waste becomes smaller to facilitate the composting process. Composting is the process of collecting and separating organic and non organic waste. Then the separated waste will be destroyed and compost-forming substances are given. After 14 days the waste will change color to blackish and become softer, the waste compost has matured enough. The compost is then harvested and taken to a place for further processing. The benefits that can be obtained from processing waste into organic fertilizer in the form of reducing the volume of waste transported to the Final Disposal Site so that it will save supporting power such as vehicle fuel and other operations. Then the public's perception of waste, especially livestock manure which seems dirty and smelly, will decrease if the right processing is carried out to be used as organic fertilizer, because it does not smell and has more value[3]. In addition, processing waste into organic fertilizer is also an effort to avoid environmental damage due to a good waste management system. To support the processing of waste into organic fertilizer, a garbage chopper is needed to simplify the processing and be more effective. Currently, there are many waste

chopping equipment made with various specifications, for example a straw chopper is a tool for chopping dry or wet straw, which is usually used as animal feed or will be used as compost. This straw chopper uses a gasoline-fueled engine or can use gasoline engine. Corn milling machine is a machine to reduce or crush the size of dry corn shells using a crusher or hammer mill system. The results of the corn mill will be used for animal feed ingredients. The organic waste shredder is one of the waste processing machines that functions to chop organic waste into smaller sizes to be processed into organic fertilizer. This machine is an indispensable machine in the processing of waste for organic fertilizer. With raw materials that have been chopped into small sizes, it will facilitate the next process to become ready-to-use fertilizer. So that the time needed in processing organic fertilizers can be faster [4].

Previous garbage chopping machines [5] only relied on knives to produce shredded waste. As a result, the results are too large. To get smaller counts, another mechanism is needed. One of them is by adding a filter mechanism. With a filter, large pieces will remain in the chopping chamber and continue to be chopped until they reach a size that allows these pieces to pass through the filter. The organic waste chopper is made using a combustion engine. The working principle of this tool is as follows, the motor is turned on and the rotation generated by the motor is transmitted to the pulley on the shaft which directly moves the chopper blade [6]. Garbage that is entered into this machine will be chopped by the chopping knife contained in the chopping drum. After the garbage is crushed, the debris or waste grains will come out through the hole where the debris or debris is released with a size of 2 mm to 5 mm.

Methode

Design and Development

After searching for data and making concepts obtained from the literature study of the literature as well as from the survey results, it can be planned the machine elements (dynamic parts) of the design and manufacture of organic waste counting machines. Planning and Design is the first step of making a machine, planning for making this machine must be done properly so that the machine that is made later can work optimally, the planning carried out includes:

1. Power planning;
2. Capacity planning;
3. Planning of chopping blades;
4. Pulley and v-belt planning;
5. Shaft and key planning;
6. Bearing planning.

Manufacturing Process

The manufacturing process is carried out after all the planning and design processes are completed. The chopping blade is made of plates with a length of 160mm. The knife holder is also made of tubular plates with a diameter of 250 mm and a length of 500 mm.

1. Shaft making
2. Making chopper blades

Assembly Process

The assembly process is carried out after the manufacturing process (machining) is complete, so that it will form a "Waste Counting Machine". The assembly process of waste shredder parts includes:

1. Installing the bearing on the frame;
2. Install the chopper blade on the shaft;
3. Install the chopper cover body;
4. Mounting the shaft on the bearing;
5. Install the pulley on the shaft;
6. Installing the motor as well as the motor pulley;
7. Adjust the distance of the motor pulley with the shaft pulley;
8. Installing the V-belt.

Machine Testing

Tool testing is carried out to determine whether the garbage chopper machine can work properly. The things that are done in testing the tool are as follows:

1. See if the machine elements are working properly;
2. See if the machine element fastening bolts are not loose, not loosened, and not broken;
3. Measure the time for enumeration;

4. View the results of the enumeration

Machine Improvement

Completion of this machine is carried out if the tool testing stage has problems or deficiencies, so that it cannot function properly according to the procedures, objectives and planning carried out.

Result and Discussion

A waste processing machine that can destroy organic waste is planned to have a capacity of 1200 kg / 8 hours. This waste processing machine has advantages: it uses simple technology, can be operated by only 2 people, is economical and easy to maintain. This garbage crusher has the following specifications:

1. Length x width x height = 1.5 x 1.25 x 1.25 meters.
2. Waste processing capacity = 1200 kg / 8 working hours.
3. Using a gasoline engine with a power of 6.5 hp to drive the rotary blade.
4. Rotary model of 90o vertical blade rotary crusher.



Figure 1. The designed organic waste crusher machine

Power Planning Results

The cutting force of the garbage chopper (F) is 0.4 kg. With a radius of 277.5mm chopping tube. Then the torque that occurs (T) is 320 kg.mm. The power required to cut the waste (P) is 390 W, the value of the correction factor (fc) is 0.8 , so the planned power (Pd) is 630 W.

Capacity Planning

After knowing the cross-sectional area of the blade (A) is 0.0016 mm², n = 1200 rpm then calculate the volume of waste from the experimental results (V) is 0.01413 m³. From this volume, it can be found that the density of the waste counter (ρ) is 70 kg/m³, the cutting knife speed (V) is 282.6 m/min. Then the capacity of the garbage chopper (Q) is 70 kg/minute.

Pulley and V-Belt Planning Results

The motor used is 6.5 HP and the motor rotation speed is 1400 rpm. The driving pulley diameter = 95 mm and the driven pulley diameter = 180 mm, the length of the belt used is L = 1044 mm. shaft axis distance (C) = 1226 mm. The required reduction ratio (i) = 1.83. From these data, the belt used is type A with the following specifications = 36°; W= 16.07; Lo= 12.5; K= 5.5; Ko = 9.5 ; e = 19.0 ; f = 12.5.

Shaft and Stake Planning.

The shaft material to be used is S30C. With a tensile strength specification (σ_B) = 48 kg/mm², the weight of the blade is 16.4 kg, the weight of the pulley is 1 kg, the pulley's tensile force is 7.17 kg. The force on RA = 0.97 kg and RB = 17.37 kg. The biggest moment that occurs is 2336 kg with a large torque (T_2) = 319.7 kg.mm. the safety factors (Sf1) and (Sf2) used are 6 (because they use S-C material) and 2.0 (because the shaft is given a keyway) while the bending factor (Km) is taken as 1.5 because the impact load is large, the torsion factor is (Kt) taken a value of 2.0 because there was a big shock/collision, the allowable bending stress (τ_a) = 4 kg/mm². To design the pegs, one must know the tangential force (F), the magnitude of the tangential force is F = 16.82 kg. The diameter of the shaft is 38 mm with S30C dowel material with tensile strength (σ_B) = 48 kg/mm with safety factor (Sf1) = 6 and (Sf2) = 2.0. The length of the stake (lk) = 65 mm, the width of the stake (b) = 10 mm, and the height of the stake (h) = 5 mm.

Bearing Planning Results

The bearings to be used are angular ball rolling bearings in an installed state with bearing number open type UCP 205-24, which has the following specifications: d = 38 ; D = 80; B = 20 ; r = 1. The radial load on the bearing (Fr) = 17.37 kg and the axial load of the bearing (Fa) = 0 So that the X factor = 0.56, V = 1 and the Y factor = 0, because the bearings used are radial bearings, the bearing equivalent load is 9,72 kg. The bearing speed factor is (fn) = 0.01, and the bearing life factor is (fh) = 6.59. Bearing nominal life (Lh) = 143095.59 hours with a reliability factor of bearing life (Ln) = 143095.59 hours.

Organic Waste Crusher Machine Test

This machine testing was carried out in the Welding Laboratory of the Mechanical Engineering Department, Faculty of Engineering, University of Jember. The objectives of the machine experiment are:

- Knowing the performance of the garbage chopper.
- Knowing the results of the enumeration.
- Knowing the capacity of the waste crusher machine.
- Knowing the success rate of enumeration.

Table 1 Test Results of the Waste Crusher Machine:

Test	W1 (kg)	W2 (kg)	t (min)
1	1,024	0,620	1
2	0,391	0,338	1,05
3	0.618	0,549	1
4	0,522	0,495	1,6
Total	2,56	2,002	4,65

Note:

W1 = Weight of waste before loading into hopper (kg)

W2 = Weight of waste that comes out (kg)

t = Material counting time (minutes)

$$\begin{aligned}
 \text{Chopped \& out trash} &= \frac{W_2}{W_1} \times 100 \% \\
 &= \frac{2,002\text{kg}}{2,56\text{kg}} \times 100 \% \\
 &= 78,20\% \text{ from initial weight}
 \end{aligned}$$

So in every single process, the waste that does not come out is 21.8% or 0.558 kg. Machine capacity (Q) = 2.56 kg in 4.65 minutes, so the capacity obtained is 120 kg/hour. After testing, the engine capacity is as expected.



Figure 2. Results of organic materials crushing

Conclusions

Based on the results of the design and testing of organic materials crushing machines, it can be concluded that:

1. The power required to crushing organic materials is 390 W.
2. The diameter of the driven pulley is 95 mm and the diameter of the driven pulley is 180 mm.
3. The shaft material used is S30C with tensile strength (σ_B) = 48 kg/mm². The diameter of the shaft used is 38 mm and the length of the shaft is 780 mm.
4. Based on the test results, the percentage of waste that comes out is 92.8%, the remaining 7.2% or 0.558 kg does not come out, this happens in every single process.
5. The capacity of the organic waste crusher is 120 kg/hours at 1400 rpm rotation and the organic materials is chopped with a size of 2-3 cm.

Suggestion

In implementing the design and manufacture of this organic waste crushing machine, there are still things that need to be suggested, including:

1. It is recommended to give the diesel engine a higher speed (above 1400 rpm) so that the waste can be chopped up quickly and smoothly.
2. It is recommended to make the drum using a thicker plate material (above 3 mm) so that the engine sound is not too noisy.

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