

Multifunction Hammer Mill Machine Design and Assembling to Destroy an Agricultural Wastes

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Abstract-The consequences of the agricultural sector is abundant of agricultural waste. An agricultural waste to be able to further processing need to cutting or the destruction of formerly. One needs in treating waste agricultural sector is crushing machine. Because of that required the design and machine fabrication hammer mill multi function. The variables used to know the machine work on optimal mill in enumerate/destroy raw materials waste were rotation motor, the angle of the blades and the number of blade. Specifications of multifunction machine hammer mill were (1) capacity 300 kg/hours, (2) dimensions (length x wide x high) : 115 x 65 x 125 cm, (3) engine power 5.5 PK Honda or electric motor 2 HP, (4) cold work steel knife (58-60 hrc), (5) knock down knife system, (6) plate holder : iron pipe \varnothing 40 mm, (7) material of the frame : iron plate 2" and iron elbow 60 x 60 cm, (8) multifunction : cutting, destroying, and milling of straw, leaves, twigs, Other organic matter. Observations and testing offered machine work multifunction hammer mill shows that the quality of an agricultural waste broken down optimal needed 1250 rpm, blade angle 30° and the number of blade 9 pcs.

Key words : blade, blade angle, hammer mill, machine, multifunction

I. INTRODUCTION

Indonesia is well-known as agrarian country whose the occupation of population dominated by agricultural industry. One disadvantage of agricultural industry is the agricultural waste. The waste must be recycled thus won't be environmental problem. Agricultural wastes are defined as the residues from the growing and processing of raw agricultural products such as fruits, vegetables, meat, poultry, dairy products, and crops [1].

Agricultural waste consists of leaves, branches, twigs, which is hard and not easily destroyed. Agricultural waste should be cut before recycling it. One of the solution is create the destroyer machine to cut or destroy the agricultural waste. The goal is the destroyed waste will be processed.

Hammer mill already used and created for cut, refine, etc. Budiarto, (2010) use hammer mill for refine fruits sludge [2]. Hammer mill used for [3]. Hammer assembly for wood reducing hammer mills and other comminuting machines and methods of making and using it already patented [4]. Reversible hammers for hammer mills juga already patented [5]. The goal of the creation of this multifunction hammer mill is to help destroy the agricultural waste by cut and destroy the waste before it will get other process.

II. MATERIALS AND METHODS

A. Materials

Materials consists of Engine 5.5 PK Honda or Electric Motor 2 HP; cold work steel (58-60 hrc), knock down knife system, plate holder : iron pipe \varnothing 40 mm, material of the frame : iron plate 2" and iron elbow 60 x 60 cm. The computer which used to design machine of hammer mill has specification Processor : Core 2 duo 2.4 ghz; Mainboard Intel 945; Ram : 1 Gb; Hardisk : 40 dan 80 Gb; Memory : DDR2 1 Gb; Monitor : Primera dan Milenia 17 inch (flat), Software : autocad 2010, CATIA R15. Assembling use some machine such as Mesin CNC bubut (Fanuc, Lead Well Ser No. L2SIE 0433). Mesin CNC Milling (Merk Chevalier type 1418 VMC-40).

B. Methods

The creation of the multifunction hammer mill started on observation of the condition of agricultural waste. The result are data about the characteristic of wastes, input system of waste destroyer, and concept of multifunction hammer mill. After the design is followed by preparation of ingredients and tools and then assembling. Performance test is done after the machine has been assembled. Overview of hammer mill machine bolting as shown in Figure 1.

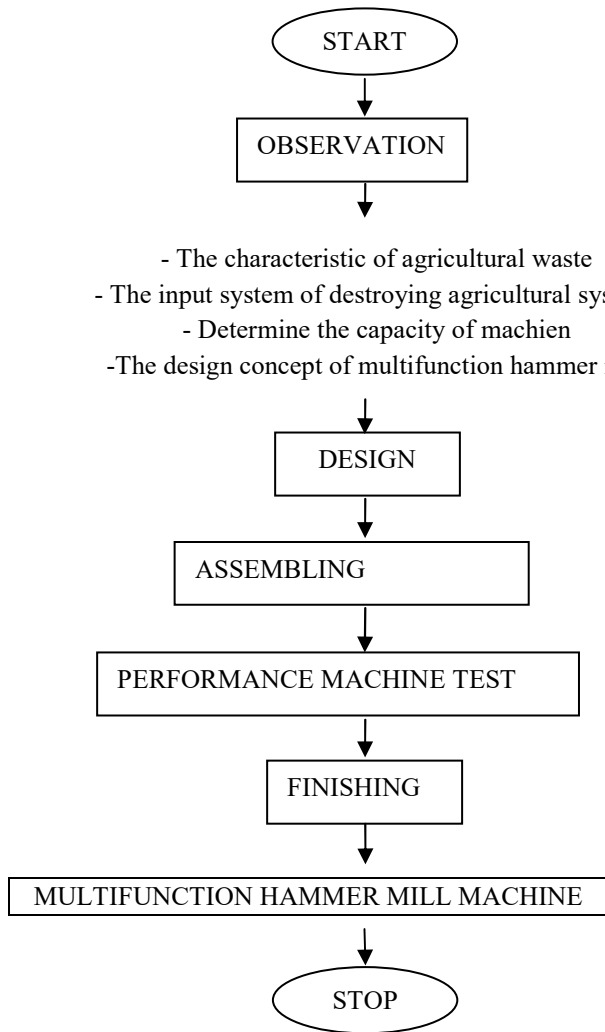


Figure 1. The Manufacturing Diagram of Multifunction Hammer Mill Machine

III. RESULTS AND DISCUSSION

A. Machine Design

Multifunction Hammer Mill Machine is designed according to the needs of the village people who need to solve the problem of abundant agricultural waste. The equipment needed is simple, inexpensive and easy to operate. Therefore this machine is designed with medium capacity with its parts including inlet chamber, engine, drive motor, belt, frame, plate holder, etc. This machine design is shown in Figure 2

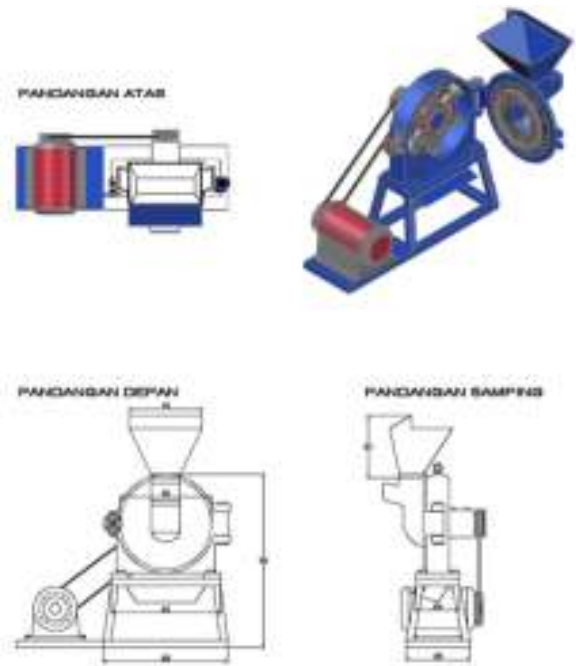


Figure 2. Gambar design Multifunction Hammer Mill Machine

B. The Result of Assembling

Assembling that has been carried out according to design produces one hammer mill machine unit with the following specifications, 1) Capacity: 300 kg / hour 2) Dimensions: 115 x 65 x 125 cm, 3) Power: engine 5.5 PK Honda or Electric Motor 2 HP, 4) Blade: cold work steel (58-60 hrc), 5) Blade system: knock down can be disassembled , 6) Seat plate: Iron pipe □□40 mm, 7) Frame material: Iron plate strip 2 "and iron elbow 60x60 cm, 8) Function: cutting, destroying, and smoothing straw, twigs, livestock droppings, and organic matter Other results of assembling Multifunction Hammer Mill Machine as shown in Figure 3



Figure 3. Assembling Multifunction Hammer Mill Machine

C. Performance Machine test

Testing of Multifunction Hammer Mill Machine aims to determine the performance or performance of the machine. This machine can be used to destroy / chop / cut jatropa plant waste, straw, leaves, twigs, livestock manure and other organic waste. This machine has a capacity of 300 kg / hour.

In this test is done by adjusting the motor rotation, number of blades, blade angle. The motor rotation setting is done to get the optimal rotation in the enumeration process. Furthermore, setting the number of blades and the angle of the blade is done to find out how many blades with the optimal blade position to count waste with the best quality and high capacity. However, because the waste that is put into it has different characteristics, then the arrangement of this variation is based on waste that has almost the same characteristics.

- 1) The steps taken in the operation of this hammer mill machine are as follows:
- 2) Before starting the engine, it is ascertained that the drive motor with gasoline is in a state of approximately 2.5 liters of gasoline.
- 3) The motor is turned on with no load conditions.
- 4) After the motor drive is on, the gas is adjusted and the motor rotation is adjusted to the desired output capacity.
- 5) Waste to be destroyed, is inserted continuously through an inlet.
- 6) The sack is placed in a funnel out put to accommodate the crushed product. If the waste destruction process has been completed, the remnants of the material are cleaned, especially in the blade housing.
- 7) Waste which is to be destroyed, is inserted continuously through an inlet.
- 8) The sack is placed in a funnel out put to accommodate the results of the destruction.
- 9) If the waste destruction process has been completed, the remnants of the material are cleaned, especially in the blade housing.

D. Blade angle setting

Blade angle adjustment is performed to determine the exact and optimal position of the blade angle to produce the best engine performance that can produce optimal destruction. Variations in the angle settings used are 30°, 45° and 60°. In each blade angle variation, the sampling process of waste counting / destruction is carried out 3 times. In the blade angle setting, high precision is needed, so that the enumeration process is fast and easy to go out. By fitting the right angle position, the blade turns to chop faster, and the chopped results are softer and faster to get to the outer funnel. Blade angle variation testing is shown in Figure 4.



Figure 4. Examination of variasi blade angle

E. Setting the number of blades

This hammer mill machine has 9 chopping blades, of which 6 knives are in the knock down position, while 3 blades are in a fixed position. Setting the number of blades aims to determine the optimal number of blades to count organic waste so that the fast counting process with quality chopped results. This knife serves to destroy the material (waste) that is in the blade housing. The blade works with a rotary system, where the cutting speed adjusts the motor rotation speed as the input rotation. Setting the number of counter knives is shown in Figure 5.



Figure 5. Setting the number of Blade

F. Motor rotation settings

Tests are also carried out by varying the rotation of the gasoline motor, in order to obtain optimum rotation for each waste raw material. The optimal round obtained can be used as a reference in the next waste counting process. In this test, the motor rotation variation used is 100 rpm, 1250 rpm and 1500 rpm. The measurement of this motor rotation uses a tachometer. This arrangement is done by adjusting the size of the gas (power engine). The higher

the rotation, the higher the energy produced to destroy waste so that the rate of waste counting is faster. Figure 6 below is setting the motor rotation on a hammer mill machine.



Figure 6. Setting of cycle engine

The performance of hammer mill is determined significantly by the speed of hammer rotation and mill hole sieve. The change of rotation speed from 1400 RPM to 3600 RPM increase four times the production capacity and the change of sieve size from 6mm to 2mm double the production capacity. However, the increase of number of hammer swings affect slightly the production capacity. Hammer mill equipped with 6 mm and four swing rotates at 3600 RPM is considered to be optimum with production capacity of 28 kg / hr having particle average diameter of 334 micron[2].

IV. CONCLUSION

A hammer mill machine has been produced which is used to destroy / chop / cut agricultural waste such as jatropha leaves, straw, leaves, twigs, cattle dung and other organic waste. This machine has a capacity of 300 kg / hour. Multifunction Hammer Mill Machine has a capacity specification of 300 kg / hour; dimensions (LxWxH): 115 x 65 x 125 cm; Power: engine 5.5 PK Honda or 2 HP Electric Motor; Blade: cold work steel (58-60 hrc); Blade system: knock down can be dismantled; Seat plate: Iron pipe □□40 mm; Frame material: Iron strip plate 2 "and angled iron 60x60 cm; Multifunctional.

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