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Research Article

Manufacture of Composite Plastic Pellet Seed Machine Capacity 2.5 Kg/Hour

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A B S T R A C T

Natural fibers are a material that is easily obtained from nature, both animals and plants. Using natural fibers has been commercially applied in various fields, such as automotive and construction, by mixing PPHI (Polypropylene High Impact) with injection molding and forming plastic pellets. Pellets are extruded with natural pineapple fiber for composite, which requires a composite pellet-making machine. The machine combines two materials that are not aligned with the material mixing method using a screw inside the barrel, then heated by a heater. The screw pushes the pellets that have been mixed and melted to the die and then dried with water, which will go to the Crusher to get chopped into composite pellet seeds. In this research, a plastic extruder machine with a capacity of 2.5 Kg/hour components used a single screw, heater, die, Crusher, barrel, and hopper, and the time delay in this study is 165º and 180º. The screw rotation is constant at 15 rpm, using a screw diameter of 20 mm x 550 mm and a pitch distance of 1D with an inclination angle of 23º.

1. INTRODUCTION

Natural fiber is a material derived from nature, sourced from both animals and plants, which is easily obtained by humans at a low price, easy to process, low density, and environmentally friendly. It can be decomposed biologically, such as natural plant fibers in the form of bamboo, banana fronds, pineapple, coconut, palm fiber, etc. The use of natural fibers as composite fillers has been applied commercially in various fields, such as the automotive and construction fields, such as ship, car, and motorcycle casings made of composite materials. Using natural fibers as composite fillers have been commercially applied in various fields, such as automotive and construction. Such as ship, car, and motorcycle casings made of composite materials. [1][2].

Composite material is formed due to a mixture or combination of two or more forming materials through a mixture that is not homogeneous because the mechanical properties of the forming materials are different in the journal. [3][4]. In the automotive field, for example, on automatic motorcycles that use CVT (Continuous Variable Timing) power forwarders, more parts are used so the motor can run. These components work with their respective functions, like the slide piece component on the front pulley. This slide piece is made of hard plastic that works up and down as the engine rotates. This part rubs against the front pulley and receives pressure due to high rotation. [5][6].

The material used to make composite plastic pellets must have a composition of 80% polypropylene and natural fiber with a volume fraction of 20%. It aims

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to make composite pellets becoming stronger than just using PPHI without fiber. The process of making composite plastic seeds using a pelletizing extruder machine. The extruder machine would help a process of changing extruded plastic (changing the solid form to liquid). This changing process goes through various stages, including the material that already in the hopper falling can be precisely falling into the feeding zone (barrel). [7], [8].

This feeding zone has a shallow area. This area has a temperature of 165º and 180º and constant screw rotation at 60 rpm to ensure the two materials are mixed evenly. This research aims to make a plastic pellet seed machine by developing previous research without using a mixer in the hopper to mix the two materials. [7].

2. METHODOLOGY

2.1. Flow Chart

The design carried out during the manufacture of machines or tools in this study comprises of the literature study and the fabrication of the machines [9]–[11]. A complete stage of design process is given according to the Figure 1.

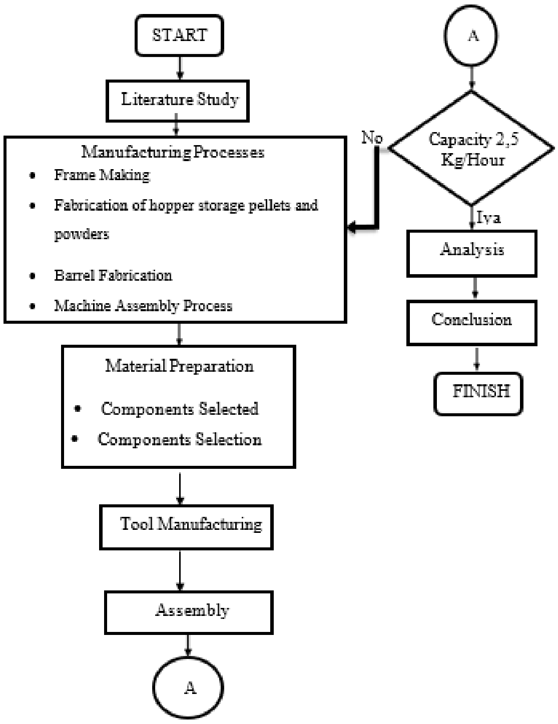


Figure 1. Flowchart

2.2. Schematic of Machine Manufacture

A Solidworks software was employed to help in design process. The schematic concept of the proposed machine is given in Figure 2.

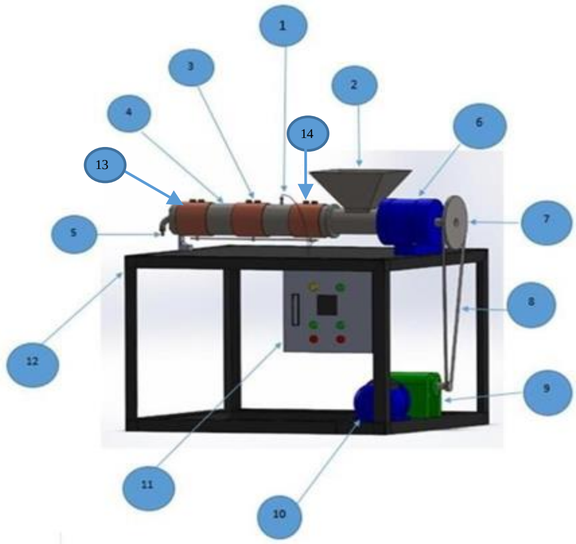


Figure 2. Schematic of Machine Manufacture

Description:

1. Temperature Sensor	9. Gearbox
2. Hopper	10. Electric Motor
3. Heater 2	11. Panel Controller
4. Barrel	12. Frame
5. Nozzles	13. Heater 3
6. Home Bearing	14. Heater 1
7. Pulley	
8. V-belt	

2.3. Design Process

In the process of making components and sizes must be in accordance with the design of the production process in the parameters of the machining process as the main procedure for the work process and the calculation of tool specifications to be appropriate, in the selection and calculation of the screws used. [12].

a. Diameter *screw*

$$D = \sqrt[3]{\frac{4\,x\,Q}{60\,.\,\pi\,.s\,.n\,.i\,.y\,.\,C}} \tag{1}$$

Then:

$$D = \sqrt[3]{\frac{(40\,x\,2{,}5\,\frac{kg}{h})}{(60\,.\,3{,}14\,.\,1\,.\,15\,.\,0{,}4\,.\,2{,}5\,\frac{kg^3}{h}\,.\,0{,}65)}}$$

D = 0,0028 m = 1 inch

b. Rotation ratio comparison

$$N_2 = \frac{N_1}{i} \tag{2}$$

Then:

$$N_2 = \frac{1500\ rpm}{50}$$
$$N_2 = 30\ rpm$$

The ratio or comparison obtained is N_2 : N_1. Where N_2 = 15, dan N_1 = 30 comparation 1 : 2.

c. Finding the Spindle Speed

$$n = \frac{vc.1000}{\pi.Dp} \quad (3)$$

Then:

$$n = \frac{20.1000\ mm/mnt}{\pi.7mm}$$
$$n = 909{,}92\ rpm$$

d. Seeking Feeding Speed

$$vf = f\ .zph \quad (4)$$

Then:

$$vf = 0{,}5\ mm\ .4.909{,}918$$
$$vf = 1819{,}836 \frac{mm}{minute}$$

e. Depth of Cut

$$a = to - ti \quad (5)$$

Then:

$$a = 28mm - 24{,}44mm$$
$$a = 3{,}56\ mm$$

Performed 7 passes

f. Feeding Time

$$Tc = \frac{lv+lw+ln}{vf} \quad (6)$$

Then:

$$Tc = \frac{2mm + 82mm + 7mm}{1819{,}836 \frac{mm}{minute}}$$
$$Tc = 0{,}054\ minute$$

g. Effective Time

$$Teff\ enmill = Tc.z \quad (7)$$

Then:

$$Teff\ enmill = 0{,}054\ minute\ .7\ mm$$
$$Teff\ enmill = 0{,}38\ minute$$

3. RESULT AND DISCUSSION

3.1. *Mavhine Manufacturing*

In the manufacture of this composite plastic pellet seed machine, including Figure 2.

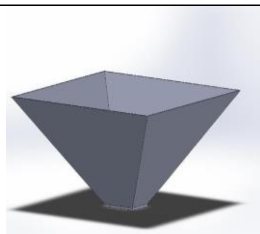
Machine Manufacturing	Description
 Frame	Frame manufacturing processes: 1. Cutting Process 2. Welding Process 3. Drilling Process 4. Smoothing Process
 Barrel	Barrel manufacturing processes: 1. Turning Process 2. Welding process 3. Cutting process
 *Screw*	Screw manufacturing processes: 1. Cutting Process 2. Turning Process
 *Hopper*	Hopper manufacturing processes: 1. Cutting Process 2. Welding Process
 Cooling Tub	Cooling basin manufacturing processes: 1. Cutting process 2. Welding process
 Cutting Machine	Manufacturing processes of the cutting machine: 1. Cutting Process 2. Turning Process 3. Welding Process

Figure 3. Machine Manufacturing

3.2. *Test Procedure*

When conducting the testing process, there are several steps to test the composite plastic pellet seed machine as follows [13], [14]:

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1. Preparation of the machine to be tested.

Figure 4. Seed Pellet Machine

2. Connect the control box plug to the power ternimal.

Figure 5. Power Terminal

3. Input PPHI plastic seed material and pineapple leaf fiber powder into the hopper at a mix percentage of 80% and 20%.

Figure 6: Put the material in the hopper

4. Connect the central MCB to the control box

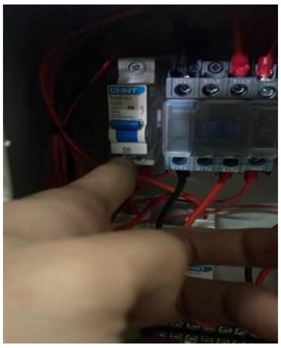

Figure 7. Start MCB

5. Turn on the heater on the control box and then turn on the heater to a temperature of 195^{0}C.

Figure 8. Start Heater

6. Turn on the electric motor on the control box

Figure 9: Start the Electric Motor

7. The molten material that has been melted will come out through the nozzle.

Figure 10. Mixing PPHI and Powder

8. Plastic seed material mixed with pineapple leaf fiber powder enters the cooling bath.

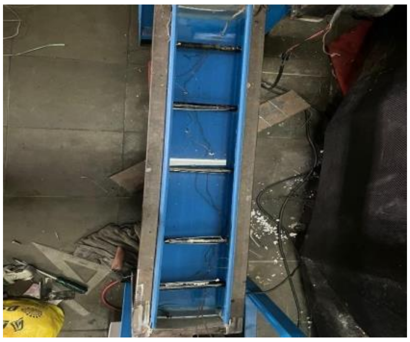

Figure 11. Tub Cooling

9. The cooled material is then fed into the cutting machine to become composite pellets.

Figure 12. Composite Pellets

4. CONCLUSION

For the discussion of the results of this conclusion obtained are:

1. The suitable extrusion process temperature for producing cylindrical bars with a single screw at a screw rotation speed of 15 rpm is 195 °c.
2. At lower temperatures (150ºc, the plastic granules are not yet fully viscous).
3. In the extruder process of PPHI, which has been mixed with pineapple fiber powder at a temperature of 195ºC, cavities are not filled. This is caused by pineapple fiber that does not melt because pineapple fiber is not a chemical that can be melted.
4. There are 4 heaters, and each heater must be set first in the thermocouple: The first heater is 2150C, the second heater is 2000C, the third heater is 1950C, and the fourth heater is 1950C.
5. Setting the cutting machine at 15 rpm results in 80% more uniformity than at 20 rpm.

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