

Design and Fabrication of Agricultural Waste Shredder Machine

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ABSTRACT

The scope of this work is to design and develop a Shredder machine focusing on chopping of agricultural wastes such as coconut leaves, areca leaves etc., and this chopped waste can then be used to prepare the vermin-compost. Concepts were developed with reference of 4 completely different device machines and in operation processes. This idea is incorporated by considering the security issue users in operation atmosphere and maintenance. Focusing the need of users requirement and purchasing for capability, a prototype was fabricated. The main parts in this equipment which are three-phase motor, bearings, structural frame, cutter and a shaft. The shredder equipment frame is built by using a material mild steel and stainless steel for cutter tip preparation. There are two cutters are mounted on the shaft. The power derived from the electrical motor which is transmitted to cutter shaft through a belt drive assembly. Cutting action is formed within the chopping house because of the result of tensile, friction, and impact result in chopping method. The chopped waste is finally collected at the bottom.

Keywords: Shredder machine, Fabrication, Methodology, Agriculture waste.

INTRODUCTION

Agriculture may be a lot of reinforced business in various items of the globe, making a scope of wastewaters requiring AN assortment of treatment innovations and therefore the board rehearses. The essential management of concerning seventieth of people in India is agriculture. AN assortment of yields square measure developed in India, but within the wake of aggregation them the harvest deposits square measure either singed or tossed as waste stupidly concerning their nourishing esteem. Any organic matter that's viewed as a waste is not in any respect a waste. It very well could also be modified over to a ranch squander, garden. The bounds to oblige agricultural waste got from agriculture and cultivating exercises square measure recognized during this. Models are given

of however business enterprise and completely different practices embraced at farm – scale sway on nature. At the purpose once free to the planet, rural squanders is each advantageous and negative to living issue and it'll so likewise address the upsides and disadvantages of waste got from agriculture within the gift condition. Given rural squanders aren't confined to specific space, however instead square measure taken broadly speaking, their impact on common assets, for instance, surface and ground waters, soil and harvests, even as human well-being, can likewise be cared-for. The agricultural waste device machine intends to decrease the agro-waste and convert it into valuable sustaining compost. Business enterprise may be a standout amongst the foremost important

segments within the Indian economy. Cocoa palm development is one in all the important jobs of ranchers of Kerala and state. It's been understood that substantial quantity of farming squanders remains being un-used in light-weight of the very fact that taking care of, capability and therefore the board connected challenges. The explanations square measure their Low Mass thickness, intensive territory/volume for capability. The ranchers on the sphere consume the bulk of those losses when the gathering of harvests. Therefore, the farming waste overwhelming wonders is being rehashed every year. Thus on utilize these losses for a few financial blessings, that the important of such machine was felt to use a large vary of agricultural squanders after destroying, that may be cheap and practicable.

BACKGROUND

Requirement of our machine is to get motion for cutting and cutting off of agricultural wastes. Rotation around a rigid axis or a few fixed axis of revolution or motion with relevancy a set axis of rotation may be a special case of motility motion. The mounted axis hypothesis excludes the likelihood of associate degree axis ever-changing its orientation, and can't describe such phenomena as unsteady or precession. In step with Euler's rotation theorem, synchronous rotation on variety of stationary axes at identical time is not possible. If 2 rotations square measure forced at identical time, a brand new axis of rotation can seem. We tend to square measure mistreatment three-phase induction motor to get the cutting operation. Generally, manual harvest involves slicing and tearing actions those leads to natural object failure thanks to compression, tension or shear. The toothed reaping hook combines a slicing and sawing action. It doesn't need

recurrent sharpening as within the case of sleek edge reaping hook. One component impact cutting is also either moving or stationary sort. A sway cutter contains a single high-speed cutting component and cuts principally thanks to inertia. This cutting technique is a cheap technique wide employed in rotary field mowers, forage choppers and in some tractor mounted cutter bar. Sometimes one component, sharp edged blade needs a rate of regarding ten m/s for impact cutting. A uninteresting edged single component blade needs a rate of regarding forty five m/s. within the rotary cutter the knives rotate in a very horizontal plane as within the rotary mowers, whereas, in flail device the knives rotate in a very vertical plane parallel to the direction of travel. In cutting off sort cutting, cutting takes place thanks to shear. A system of forces acts upon the fabric in such a fashion on cause it to fail in shear. Shear failure is invariably in the middle of some deformation in bending and compression that will increase the energy needed for cutting. a standard manner of applying the cutting force is by means that of 2 opposite cutting off parts, that meet and pass one another with very little or no clearance between them. Each or one among the weather is also moving with a linear uniform, reciprocal or motion. This kind of cutting mechanism is most generally used for harvest agricultural crops. The reciprocal cutter bars that square measure ordinarily used for harvest wheat or paddy crops use this principle. The inclined angle between the innovative is regarding thirty degrees. The toothed blades cannot simply slip between the 2 cutting edges. Reciprocal cutter bars do a superb job of harvest however square measure characterized by high- energy losses, short dynamic imbalance and restricted operational speeds.

The cutting mechanism relying entirely on cutting off utilizes the principle of cut action, that causes cutting by delivery 2 edges involved on one plane across the fabric to be cut. per se there's negligible bending or crushing and solely resistance to be overcome is that the cutting off strength of the fabric. The well-known mechanism during this class is that the pitman and reciprocal knife-bar sort mechanism. The invention of this mechanism will really be considered a "mechanical break-through" for harvest. The cutter bar has triangular knife sections riveted to a bar that reciprocates in slots of the stationary guards to chop the crop against the ledger plates of the guards. This kind of cutting mechanism is employed within the mowers, reapers, binders, forage harvesters and combines. The best potency during this mechanism is affected once there's minimum of crushing and bending of the fabric and once there's no bunching of fabric at the rear of the knife sections.

PROBLEM DEFINATION

To design and develop an AGRICULTURAL WASTE SHREDDER MACHINE, which is designed to develop a machine for shredding available agricultural wastes and using the final end products for composting.

- Fabricated machine is operated by physical that is nothing but pedal operated
- Present available machine is somewhat expensive very difficult

PROJECT MODEL/CAED MODEL

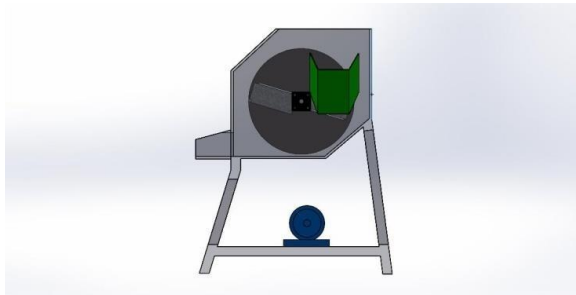


Fig. (a) Front view of Model

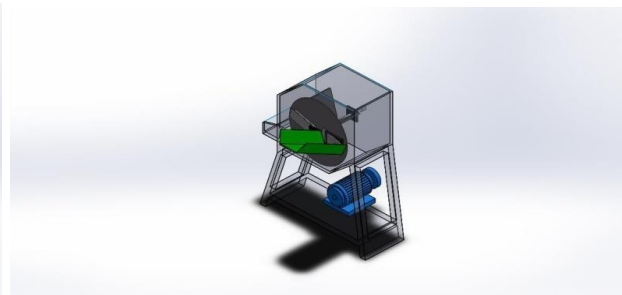


Fig. (b) isometric view of Model

to afford by common person.

- Existing equipment require floor space is requiring more which leads to maximum cost.
- Present machine has blades not that much sharp which will not give fine chopping.
- Existing machine is having much more noise.
- Present available equipment is very bulky.

LIST OF COMPONENTS USED

HP Motor, L angles, Sheet Metal, Flywheel, Blades, UCF bearings, Bolt and nut, Washer, Rivets, Shaft, Belt, Pulley.

The physical setup of this project is given below and it has been explained as follows:

- Cutter assembly
- Bearing with Bearing Cup
- Belt and Pulley assembly Frame Stand

CUTTER ASSEMBLY

The cutter assembly includes a flywheel which is mounted on a shaft. The shredder includes a single shaft for shredding operation. The fly wheel includes two cutter blades which are mounted on opposite sides of the flywheel but on the same line with the help of bolt and nut. The cutter blades are at an angle of approximately 13 degrees which gives optimum cutting action. The shaft then placed in position with the help of bearings.

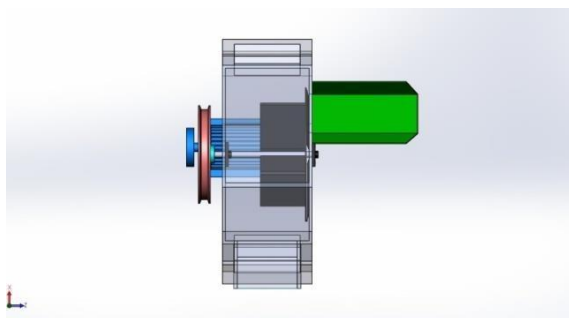


Fig. (c) Top view of Model

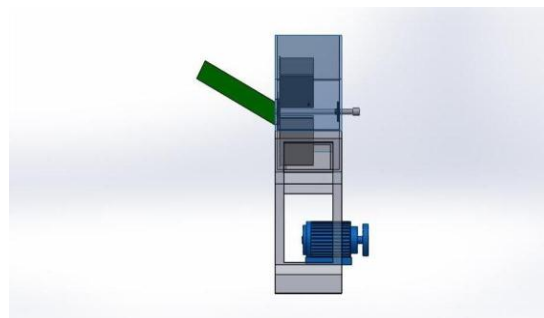


Fig. (d) Side view of Model

DESIGN CALCULATION

DESIGN SPECIFICATION

- Selected motor 0.5hp, 1380rpm
- Speed of the main shaft N₂= 460rpm
- Velocity ratio is 3 for shredding
- Motor pulley diameter, D₁=53mm
- Shaft pulley diameter, D₂=158mm
- Length of belt, L=0.67 m
- No of belt, n=1
- Diameter of flywheel = 600mm
- Thickness of flywheel = 60mm
- Pulley to motor distance = 530mm
- Hopper length = 230mm
- Hopper height = 100mm
- Taper section of hopper, t₁= 246mm, t₂= 180mm.

CALCULATIONS

Cutting force =190 N are taken from reference of wood cutting machine as mentioned in Doctoral thesis, (Lulea University of Technology, Graphic Production 2013)

Cutting force FC = 190+1 Kg/ Cutter × 9.81 FC= 205 N

RB×420 = (205×90) + (205×225) + (205×355) + (205×610) RB = 624.7 N
RA= 205 N

Bending moment, MA= 0, MB = 0
Momentum= Force×Distance

MC = 205 × 255

MC= 52274 N-mm

MD = 205 × (135+255) MD = 79950 N-mm
ME= 205×(265+255) ME = 106600 N-mm

Max B.M at Point E = 106600 N-mm
Torque

Calculation

Power = 0.5 hp = 0.37kW

$$T = \frac{60 \times p}{2 \times \pi \times n}$$

Where,

T=Torque transmitted by the shaft (N-mm). p=Transmitting power (kW).

n= Speed of transmission shaft (rpm)

$$\frac{60 \times 0.37 \times 10^6}{2 \times \pi \times 460}$$

T = 7680.955 N-mm

Calculation for Selection for Diameter of shaft

$$d = \sqrt[3]{\frac{(16 \times \sqrt{(16 \times (K_b \times M_b)^2 + (K_t \times M_t)^2})}{\pi \times \tau_{max} \times 0.75}}}$$

----- 9.10

Eq... (9.10) from Design data handbook by K.Mahadevan

Where,

Keyway factor = 0.75 Factor of safety = 2

Max bending moment Mb= 106600N-mm
Max torque Mt Torque = 28371.24 N-mm
 τ_{max} = Max shear stress (N/mm²).

K_b= stress concentration factor for normal stress
K_t= stress concentration factor shear stress

$$\tau_{max} = \frac{\sigma_y \times 0.5}{f_s}$$

Where,

τ_{max} = Max shear stress (N/mm²).
 σ_y = yield stress

F_s = factor of safety

$$66 \text{ N/mm}^2 = \frac{264 \times 0.5}{2}$$

yield stress = 0.5 u_{ultimate} = 200 N/mm²

For = Mild Steel u_{alt} = 400 mpa Eq...

(9.10) from Design data handbook by K.Mahadevan

$$d = \sqrt[3]{\frac{(16 \times \sqrt{(16 \times (1.75 \times 106600)^2 + (1.5 \times 7680.955)^2})}{\pi \times 66 \times 0.75}}$$

Therefore $d = 26.70 \text{ m}$

Standard diameter of the shaft $d = 26 \text{ mm}$

METHODOLOGY

- At first we need to fabricate the

frame of equipment as per design.

- After that we need to design the cutter and shaft as per the requirement.
- Select the motor as per the design requirement. And fabricate necessary equipment as per requirement.
- To the testing on fabricated equipment.
- If something went wrong need to look at the design calculation.
- When everything is proper proceed to chopping the waste shredder.

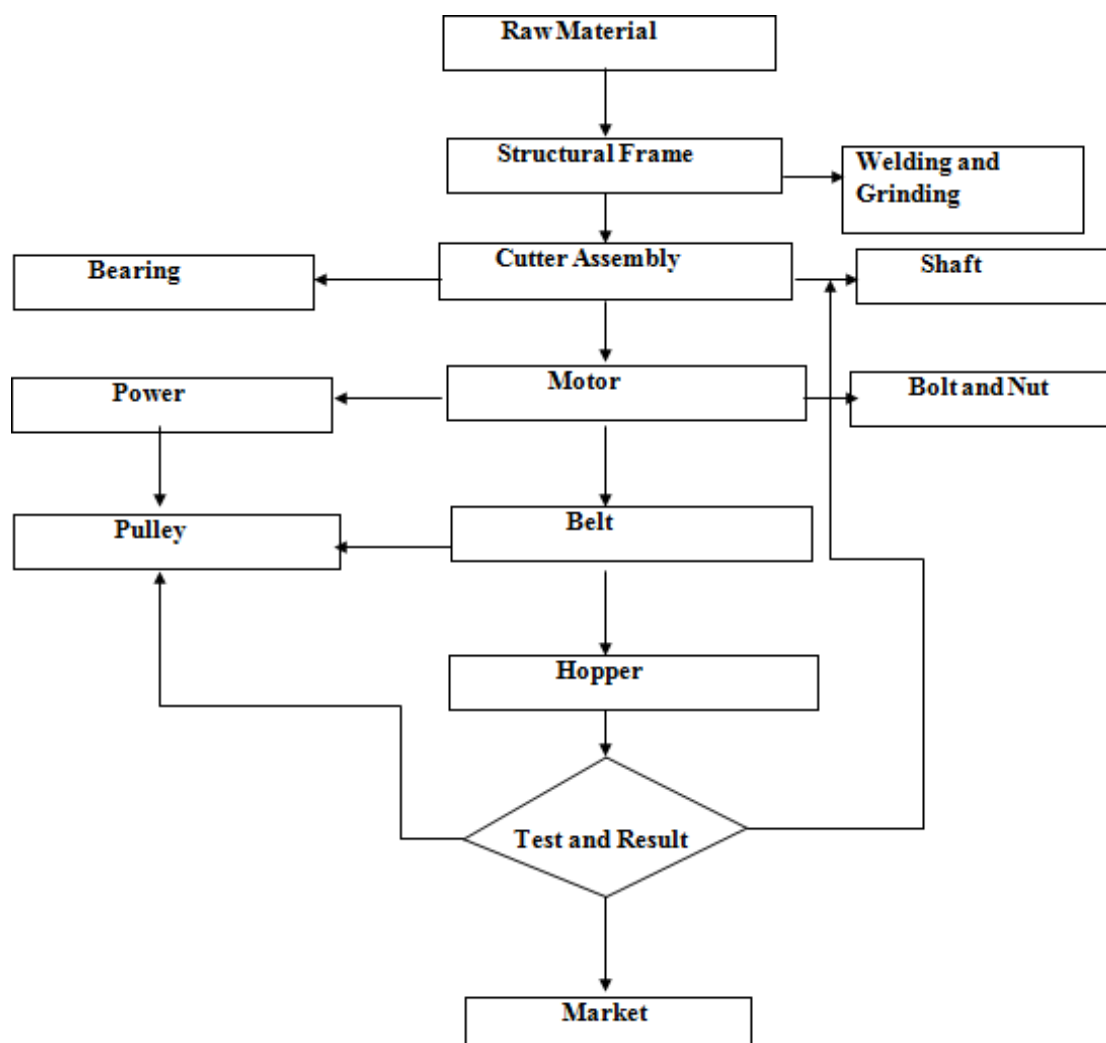


Fig. (e) Flowchart of Methodology

FABRICATED MODEL

The design is made of compactness, better maneuverability and especially for longer use.



Fig. (f) Fabricated Agricultural Waste Shredder Machine

EXPECTED OUTCOME OF THE PROJECT

- This operational machine will give the high work rate output with maximum profit by utilizing all the available energy resources
- The high work rate is due to utilization of motor powered operating machine. Advantages
- The setup is very simple in construction.
- The machine has a unique and simple design.
- The materials used are non toxic.
- The materials used are non-corrosive and do not chemically react.
- The shredded waste is released from the outlet in equal proportion.
- The wear and tear between the components is minimum.
- This has uniform output rate.
- Labour effort is less.

Disadvantages

- Feed is manual.
- High power supply is required.
- Only low to moderate feed rate is possible.

Application

- Used for agricultural waste disposal purposes.

- Obtained Agricultural waste can be used for vermicomposting.

RESULTS AND DISCUSION

- The fabricated machine will consume very less time while compared to traditional pedal operated shredder machine.
- In this fabricated machine, the human effort consumed is less.
- It can be easily carried from one place to another.
- Since the machine is motor driven, power generated is ample for smooth shredding of agricultural wastes.
- The fabricated machine can be easily cleaned.
- The fabricated machine is mainly made up of materials, which are non-corrosive in nature.
- The fabricated machine is simple mechanical system, which can be easily repaired and maintained.

SCOPE FOR IMPROVEMENT

Some of the points, which are helpful for the improvements in the design, are:

In the machine fabricated, we can increase the structural strength of the machine by providing strong base which can effectively reduce the unnecessary vibrations.

The whole machine setup.

- Currently the machine is power driven. It can be operated manually by providing a hand lever so that it can be used when power is not available and shredding of comparatively softer material is necessary.
- Feed to the machine can be made automatic by providing conveyer belt mechanism at the hopper side of the machine.
- A grinding setup can be attached to the machine which can grind the shredded waste so that the final output can be more readily used for vermi composting.

CONCLUSION

- Fabricated equipment successfully tested and which much more better resulting chopping the wastes as per requirement.
- As compare to safety which gives the very smooth working operation no hazardous to operator.
- The assembled equipment was found much more reliable.
- The overall performance was found adequate which gives proper chopping as per input quantity of wastages.
- It's used in agricultural and other purpose where very much shredders require.

AVAILABILITY OF DATA AND MATERIALS

All the data is calculated as per the standard and considered for designing the materials which is suitable to select the size of all parts. Materials availability it is there in everywhere we have purchased from the hardware stores.

COMPETING INTERESTS

Development of this kind of product which is very much essential towards the

agricultural problem are facing how to chop the wastages of agricultural. So that it will be useful for development as product.

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PHOTO GALLERY



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