

DESIGN AND FABRICATION OF SOLAR POWERED AUTOMATIC VERTICAL SHREDDING MACHINE AS A FEED FOR COMPOSTING

¹Nithin P.S, ²Seella Charan, ³Kusuma Naik H, ⁴Chandana C.M, ⁵Ashwini M.V

^{1,2,3,4} U G Students, School of Mechanical Engineering, REVA University, Bengaluru

⁵ Assistant Professor, School of Mechanical Engineering, REVA University, Bengaluru, India

Abstract: Environmental issues caused due to harmful effects of human activities is a worldwide problem causing global warming and climate change. Studies has been conducted to identify the factors of this problem and it was pointed out that agricultural interventions and practices contributes so much to the said issues. Too much dependence on the usage of chemical inputs and the burning of farm wastes was identified as the major ones. Since this issues are threat to mankind and to the existing agriculture equipment's and the shredder machine is one among them. The Shredder machines which are available in the market are powered via fossil fuels which is also contributing to global warming, this directed the researchers to design and develop a Solar-Powered Shredder machine which can be efficiently operated using solar energy without the dependency on fossil fuel. The purpose of the project is to provide our farmers a solar powered atomized vertical shredder machine that is compact in size and can be operated by using solar grid that has already been installed by the framers for the purpose of solar pump and to give an awareness on organic farming and solar farming and the importance of compost.

Index Terms – Global warming, Solar energy, Shredder machine, Compost, Organic farming, Solar farming, Automatic

I. INTRODUCTION

Developing farming and agricultural means is the reason why humans live in the world today. It is an essential means of survival, without which there can be famine all over the world. For thousands of years, agriculture was a natural process that did not harm the land on which it was done. In fact, the farmers were able to go through their land for many generations and it will still be fertile as usual. Now these days our, modern agricultural practices have started the process of agricultural pollution. This process causes the erosion of ecosystem, land and environment due to the modern agricultural products. No one can be held responsible for the huge agricultural pollution we are facing today. Agriculture is a complex activity in which development of crops and animals is fully balanced. The process of agricultural pollution stems from many stages of their development. This issue can be overcome by following organic farming. "Organic agriculture is an integrated production management system that avoids the use of synthetic fertilizers, pesticides and genetically modified organisms and reduces the pollution of air, soil and water, and improves the health of plants, animals and interdependent communities of people." "Organic farming is a unique combination of different environmental framing practices with less external inputs. It depends not only on the biological origin of fertilizers, such as fertilizers, compost, vermicomposting and the rotation of crops and companion planting, and also seeds sown through organic farming. Organic fertilizer or compost is one of the main component in organic farming. Solid organic waste like paper waste, plant waste, food waste are in macro size which as to be converted in to smaller pieces or to powder form which accelerates the process of composting by increasing the surface area of the crops residues for aerobic degradation thereby reducing the time. By using a shredder machine the macro solid waste is shredded in to powder form which is then mixed with sand form fermentation after which can be directly provide to the plants as compost or can further stored in a composter machine which stores and increasing the decomposition of the compost or manure and then can used as fertilizer to the plants. But it has been realized that large quantity of agriculture waste remains being unutilized because of handling, storage and management related difficulties. The reason are their low bulk density large area/volume for storage because of which our farmers on the field burn most of these waste after the harvesting of the crops thus the agricultural waste burning phenomena is being repeated every year without knowing its huge nutritive benefits and our framers are not equipped with right equipment's to produce organic compost. So as the compost which is one of the important material for organic farming is insufficient because of the above reasons, the farmers are not able obtain it in a cheaper price and have to depended on 3rd party sellers because of which productivity of the organic vegetables and other products reduced and farmers are forced to sell it at high rates when compared to the conventional vegetables and products. Shredder machine is used for shredding i.e. converting of macro agriculture waste and food waste into small easily decomposable form, which can used as organic manure, the small size waste will decompose faster than the large or macro size waste. Shredder machine accelerates the process of composting by increasing the surface area of the crops residues for aerobic degradation thereby reducing the time to obtain the compost from 4 months to 2 months and it also reduces the labor cost and save the energy of the labors. Shredder machine provides better storage of the compost as it is easy to store powdered compost.

II. LITERATURE REVIEW

Agriculture is one of the most important areas which plays an important role in the Indian economy. To further develop this area, technology has become one of the main agricultural sector can entitle different types. Consequently, to overcome such problems, innovative techniques which are suited to be conducted through product study, market Quality Function Deployment (QFD) was converted into technical voice. Detailed made according to the data from QFD.

P.B. khope et al, Proposed the design of empirical relationship with Chop et al, cutter. This machine used to cut fodder in animals. In the human driven flywheel for converting and transmitting human The energy stored in the flywheel can be driver paddles for 1 minute and it was seen 450 rpm with a gear ratio of 1: 2. Paddling checked for its free running. The flywheel that the effect of experimental set-up and

S.Nithyananth et al, has been developed a shredder machine is a similar attachment to a tractor-power take off shaft (PTO). Power passed to the assembly. The assembly blades. Cutting organic matter will be in preparation of vermicomposting [2].

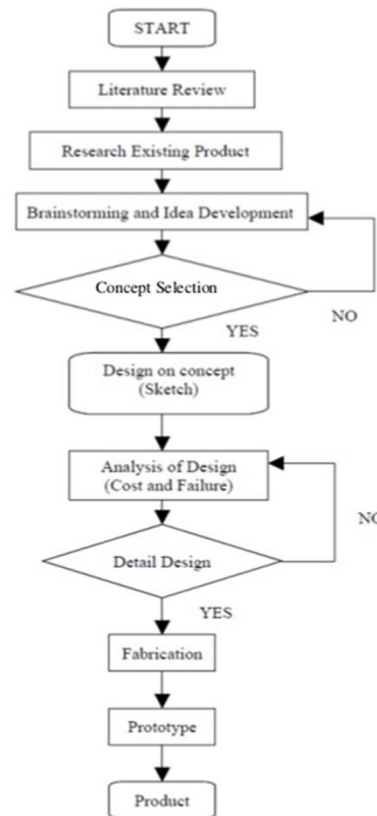
III. PROBLEM STATEMENT

Literature study was carried out based on various existing shredder machine, and field survey it is observed that Existing shredder machines are of 3 types either they are diesel powered or Tractor attachments or electrical powered machines. Diesel powered shredder machines are often bulky and large in size hence portability of this machines is a difficult task ,has it is powered by fossil fuels, the increase price and scarcity of these fuels has been a threat to the farmers and also diesel powered shredder machines are threat to the environment as these machines emits Greenhouse gases which effects both the crops and also the atmosphere thus are not “ecofriendly” .Maintenance of these machines are difficult, initial starting of the machine is a tedious process, Noisy in working condition. It works on a constant speed i.e. the speed of the machine is fixed and cannot be altered for different application and reliability of the machine is less has the replacement of the blades and other components is difficult and expensive and also finer size of the compost cannot be obtained. Electrical powered shredders are efficient then the diesel powered shredders but consumes lot of electrical power which in turn increases the electrical bill and also increases burden on farmers most of the villages and rural places farmers’ house are not even supplied by proper electricity which makes the electrical powered shredders useless as the electrical shredder machines are current dependent machines, hence cannot be portable to all places.

IV. OBJECTIVES

- [1]. To design and develop a propeller grind (blade grind) mechanism to achieve compactness and portability of the shredder machine with weight reduction
- [2]. To incorporate Hybrid powered (AC POWER, BATTERY POWER, and SOLAR POWER) feature to the shredder machine to improve the reliability of the machine
- [3]. To implement auto (on and off) shredder machine to save energy and safety purpose
- [4]. To enable multipurpose capability by incorporating multiple speed controller In the shredder machine for shredding various types of organic waste (Paper waste, plant waste, food waste)
- [5]. To provide a reliable machine and easy to maintain i.e. by providing modularity for ease of changing blades and other components of the shredder machine

V. METHODOLOGY



experimental set-up is proposed to establish human driven flywheel motor for active chef small pieces for easy consumption by motor concept, there is a cycle mechanism energy through flywheel through flywheel. used for the actual cutting process. The that the flywheel shaft reached the speed of was stopped after one minute and set-up was shaft came to rest after 30 minutes. It proved alignment of other parts was satisfactory [1].

Design of West Shredder machine. Waste plowing. The shredder can be operated with from tractor - 35 HP and above - shredder is consists of a fixed blade and five circular small pieces so that farmers can use for the

Fig.no.5.1 Methodology

VI. PRODUCT DESIGN SPECIFICATION (PDS)

Product Design Specification will give a clear idea for the designer to understand the specifications needed to design the product. On the basis of QFD results, which are produced by vendors and customer voice market studies, user studies, PDS. Here are some key criteria for product design specification as shown in the table no: 6.1.

SL no:	Description	Specification
1.	Name	Solar powered automatic shredder machine
2.	Mechanism	Vertical Propeller grind (blade grind) mechanism
3.	Target Customer	Small scale framers and general citizens
4.	Shredder Process	Motor operated
5.	Material	Carbon steel blades ,Mild steel square tube for structural frame , aluminum 6160 for adapter , aluminum 7075 for blade casing , aluminum composite panels, ply wood for electrical box ,GA sheet for hopper
6.	Manufacturing	Drilling, Indexing, lathe machining, welding, laser cutting, Bending and fabrication
7.	Safety	Automatic on/off system , cushioning rubber on sharp edges , MCB
8.	Cost	Approx. 26000/- INR
9.	Life of the product	3-4 years
10.	Motor specification	BLDC motor 1-HP 21 amps ,3900 RPM
11.	Solar panels required	5 panels of 335 w i.e. 1500kw of solar grid
12.	Battery required	48v 30 amps Lead-acid Battery (or) lithium-ion battery
13.	Ac supply required	240 v 50hz 5 amps single phase supply
14.	Charger	48v 10amp
15.	Working RPM	3500 RPM
16.	Weight	25kg
17.	Production rate	40-50kg of leafs , papers, kitchen waste per hour

Table No: 6.1 Product design specification

VII. WORKING PRINCIPLE AND DESIGN OF THE SOLAR POWERED AUTOMATIC VERTICAL SHREDDER MACHINE

The work principle provides us the functionality of the developed model. The developed model acts as an electromechanical mechanism that reduces human intervention, along with human effort, by using electric motors to cut leaves. This process is much simpler than earlier procedures'. The design incorporates propeller grind mechanism in vertical direction where the motor is mounted in vertical position and the blades are mounted on to the motor shaft. The input is feeded through a hopper in vertical direction on to the blade setup which gets chopped or grinded and the output is pushed out .The design aims to promote an environment friendly machine for farmers to mitigate the possible effects of common agricultural practices to global warming and climate change.

Generally, the design focused on the automation of the shredder machine through engineering methods using arduino Uno microcontroller. To mitigate the factors of global warming in common agriculture practices through composting and the automation of the shredder machine was actually too general. It also promotes the use of solar power instead of using fuel engine oil or gasoline in powering the machine to mitigate the effect of greenhouse gases to global warming and weather condition may actually intervene the use of solar power. Electric AC grid power and battery power was also included as an alternative for solar power as a feature of the machine. Hence in the conducted research, the source was limited only to solar power energy. The automation process of the machine was not limited to biodegradable energy leaves which means that any material placed in the machine enabled the machine to operate thus, the ability of the machine to shred any material depends on the design and material of the blades.

The system consist of arduino Uno microcontroller that controls the ultra-sonic sensor and verifies the data gathered and triggers the relay switch when input detected which runs the shredder blade of the machine making it operation mode. The machine must put in first in operation mode to the actual feeding of the actual leaf to be shred so that full turning speed of the motor will be met and to avoid sudden change in voltage .relay shield was used to protect the arduino Uno board and a relay switch will acts as the automatic switch off the system.

VIII. FABRICATION AND CAD MODEL

The below flow chart shows the fabrication flow chart of the solar powered automatic vertical shredder machine. The fabrication flowchart is mainly classified in to 3 stages as shown in the fig no: 8.1

- [1]. Fabrication of the parts stage
- [2]. Assembling of parts stage
- [3]. Finishing stage

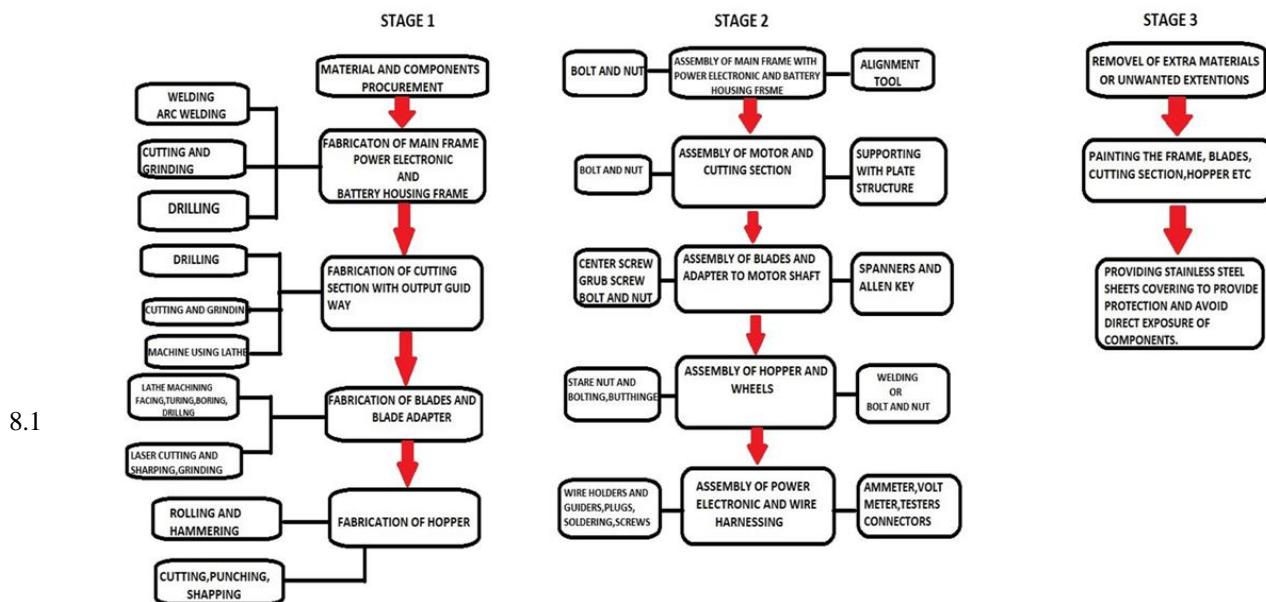


Fig no:

Fabrication flow chart

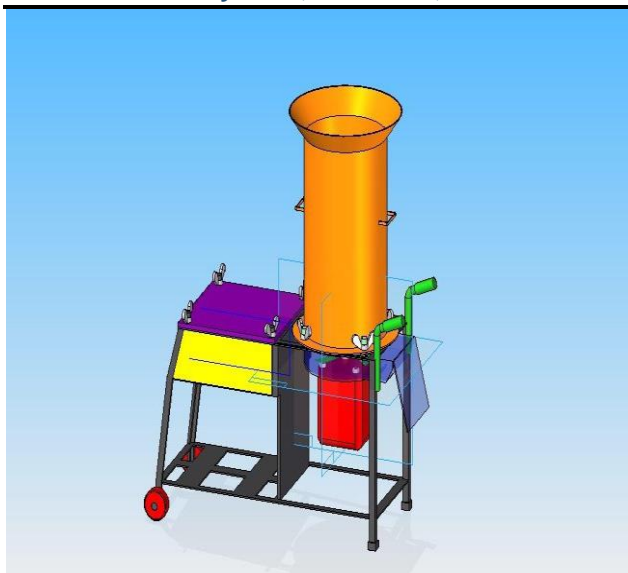


Figure no: 8.2 3-D CAD model



Figure no: 8.3 Developed model of the shredder machine



Figure no: 8.4 Output shredded leaves

IX. RESULTS AND DISCUSSIONS

The developed model was used in the collection of data in the system evaluation which was comparison of the developed shredder machine and the existing machine performance variables. Different performance measuring test where conducted and was compare with existing machine performance.

[1].Input weight versus output weight

The weight of the input leaves before shredding was compared to the output leaves after shredding in each machine as show in the below table 9.1. The weight of the input leaves was uniform at 1000grmas for the 3 trials in each machine. The rate of change in weight of output leaves after shredding differs for each machine. The rate of change in the output weight of the existing machine was greater that the output weight of the developed machine.

TRIALS	EXISTING MACHINE		DEVELOPED MACHINE	
	INPUT WEIGHT (GRAMS)	OUTPUT WEIGHT (GRAMS)	INPUT WEIGHT (GRAMS)	OUTPUT WEIGHT (GRAMS)
1	1000	900	1000	975
2	1000	950	1000	975
3	1000	925	1000	975

Table no: 9.1 Input weight versus output weight table

[2].Time versus weight of shredded leafs

In this performance test the shredder machine performance was measured using of total quantity of powered chopped for different time duration .the machine has a capacity of shredding 40-50kg of leafs, papers, kitchen waste per hour with the consideration of allowance such as machine set up time, jamming of cutter assembly etc. .The graph 9.2 shows Time vs weight of shredded leafs. The test is conducted for 5 different trials in 5 intervals of time.

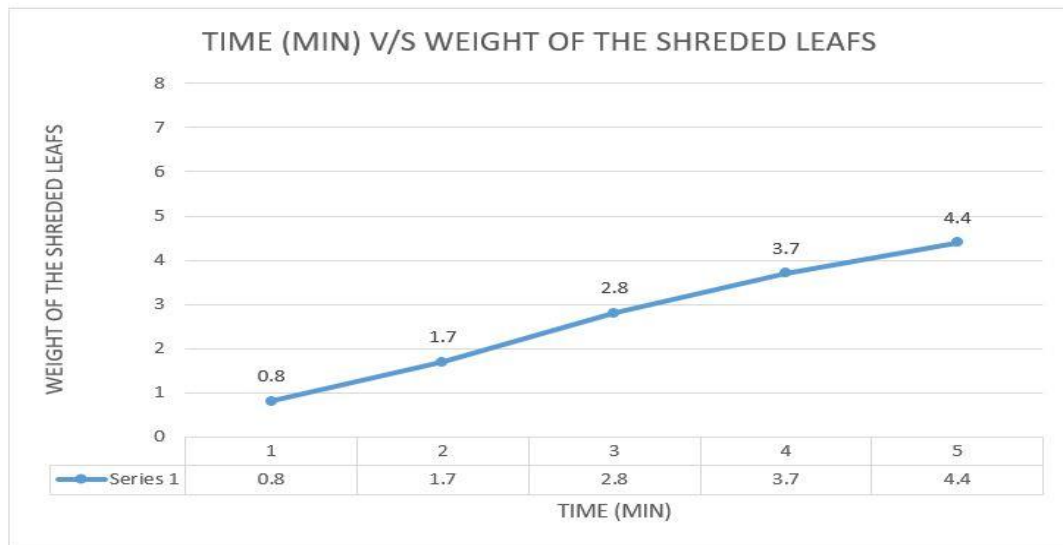


Fig no: 9.2 graphical representation of time vs weight of the shredded leafs

X. CONCLUSION

- By the use of solar powered agriculture equipment the farmers can make use of the solar grid efficiently to operate multiple devices that is economical, cost effective and environmental pollution free (Eco friendly)
- By using “SOLAR POWERED AUTOMATIC VERTICAL SHREDDER MACHINE” the farmers can shred there agriculture waste using solar power without the dependency on Ac grid power supply and can effectively shred depending on is required shape and size for compost preparation.
- Implementation of the battery and multipurpose capability enables the machine not only restricted to farmers having large solar grid but also to smaller farmers and general citizens to use the machine with a smaller solar grid or regular ac supply for the preparation of compost.
- The developed machine is simple, efficient, requires less time, and cost effective when compared to existing machine.
- The overall performance of the shredder machine is satisfactory by considering the size of the shredded substance with respected to time.

REFERENCES

- [1] P.B.Khope and J.P.Modak “Design of experimental setup-for establishing empirical relationship for chaff cutter energized by Human powered flywheel motor”, Journal of Agricultural Technology 2013 Vol.9 (4):779- 791.
- [2] S.Nithyananth, Libin Samuel et al “Design of Waste Shredder Machine”, International Journal of Engineering Research and Applications SSN: 2248-9622, Vol. 4, Issue 3(Version 1), March 2014, pp.487-491.
- [3] Ajinkya S.Hande et al. “Methology for Design & Fabrication Portable Organic Waste Chopping Machine to Obtain Compost-A Review”,IJIRST –International Journal For Innovation Research in Science & Technology| Volume 1 | Issue 7 | December 2014 ISSN (Online):2349-6010.
- [4] Dr.K.Lingaiah et al. “Machine Design Data Hand Book” Volume 1 and Volume 2.
- [5] Krishna Naik et al. “Design and Fabrication of Areca Fabrication Machine” International Journal of Emerging Technology and Advanced Engineering ISSN2250-2459, ISO9001:2008 Certified Journal, Volume 4, Issue 7, July 2014.
- [6] Y. Prashanth et al. “Design and Development of Coconut Fiber Extraction Machine”, Department of Design. S. Ramaiah School of Advanced Studies, Bangalore – 560058 Volume 13, Issue 1, April 2014.
- [7] Mohamad Khatib Iqbal, “Development of Coconut Leaves Cutter”, Vol. 3, No. 12. (June 2014) Key:cite like: 13215244.