Organic Waste Shredder Machine

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***Abstract*: Agriculture is the most important sector of the Indian economy, and it is currently one of the top two farm producers in the world. The agriculture sector employs approximately 52 percent of all people in India and accounts for approximately 18.1 percent of GDP. Agriculture provides a living for nearly two-thirds of India's employed population. According to economic data from the financial year 2020-21, agriculture contributed 20.2% of India's GDP. India's agriculture sector has taken up nearly 43% of the country's land area. As a result, the waste generated by agricultural fields is massive. So, the primary goal of this project is to create a shredding machine for chopping dry leaves.**

***Keywords*: Shredding, Shearing action, Engineering steel (EN8).**

1. Introduction

Agriculture is the major occupation in many parts of the world and produces a range of wastewaters requiring various treatment technologies and management practices. The primary occupation of 70% of the population in India is majorly dependent on Agriculture. A variety of crops are cultivated in India. But after harvesting them the crops wastage is either burnt out or thrown as waste without taking into consideration of their nutritive value. With the increase in the population, our aim is not only to stabilize agriculture production but also to increase it further in a sustainable manner. Excessive use of agrochemicals like pesticides and fertilizers over years may affect soil health and lead to declining crop yields and the quality of the products. Hence, a natural balance needs to be maintained at all costs for the existence of life and property. The obvious choice would be judicious use of agrochemicals and more and more use of naturally occurring materials in farming systems. Conventional agro-waste disposal is a traditional and oldest method of waste disposal in which agricultural wastes are dumped is to degrade in a particular place for decomposing. As the waste is dumped, it takes more time to degrade and it causes environmental pollution.

Coconut palm cultivation is one of the major livelihoods of farmers of Kerala and Karnataka. It has been realized that a large quantity of agricultural wastes remains to be unutilized because of handling, storage, and management-related difficulties.

The reasons are their low bulk density and large area/volume for storage. The farmers on the field burn most of these wastes after the harvesting of crops. Thus, the agricultural waste burning phenomenon is being repeated every year. To use these wastes for some economic benefits, so the necessity of such a machine was felt to utilize all kinds of agricultural wastes after shredding, which could be economical and practicable.

Hence the shredder machine is used for shredding i.e., converting macro agriculture waste and food waste into Coconut palm cultivation is one of the major livelihoods of farmers of Kerala and Karnataka. It has been realized that a large quantity of agricultural wastes remains to be unutilized because of handling, storage, and management-related difficulties.

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Hence the shredder machine is used for shredding i.e., converting macro agriculture waste and food waste into small easily decomposable forms, which can be used as organic manure. The small-size waste will decompose faster than the large or macro-size waste. This decomposed waste can be used for the crops and this leads to improving the growth and quality of the crops and also improving t the soil's chemical properties such as supply and retention of soil nutrients, and promotes chemical reactions.

2. Methodology

Literature Review

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Listing of Various Components Required

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Selecting the Material for Various Machine Component Production

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Fabrication of the Machine
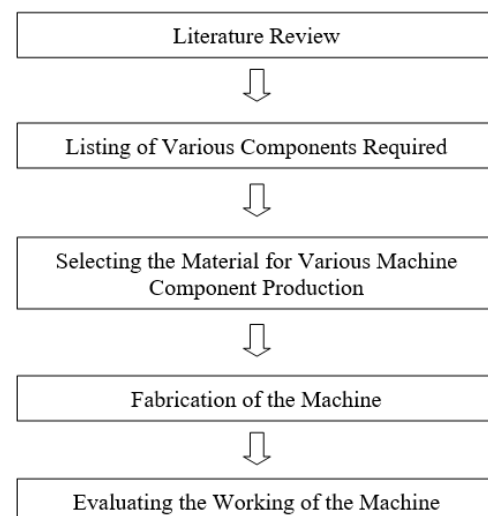
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Evaluating the Working of the Machine

Fig. 1. Methodology

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A. Construction

The machine consists of mainly the parts like structural frame, cutting assembly, and top main body/ cylindrical hopper. The structural frame provides support for the motor and the other machine components. The outlet chamber is also welded with the frame, and we connect the motor shaft directly with the blade assembly by coupling. On top of the cutting chamber, we are going to place a cylindrical hopper which is used to feed the dry leaves into the cutting assembly and also to avoid the splashing of material during the cutting operation.

B. Working

When power is applied to a three-phase AC motor with 1.5 horsepower and 1440 revolutions per minute, the motor shaft, which is directly connected to the cutting blade assembly, rotates. The blade begins to rotate at 1440rpm, and dry leaves and small twigs are fed into the cutting chamber via a hopper. The dry leaves are chopped into small pieces due to the shearing action of the blades. The small pieces of leaves in powder form will exit through the outlet chamber at the bottom.

C. Structural Frame

The frame is the main supporting structure on which the machine's other components are mounted. The frame is a welded structure made of mild steel angle. The components are rigidly attached to the frame, distributing vibration and weight evenly. The geometric structure of the main frame is intended to provide a good shape while also improving the overall stability of the structure.

D. Blade

High-speed steel is used to make the cutter. The cutter is bolted to the main shaft via a blade holder. Because the cutter is bolted to the blade holder, the blade can freely move. High Speed Steel outperforms older high-carbon steel tools that were widely used until the 1940s in that it can withstand higher temperatures without losing its temper (hardness). Because of this property, HSS can cut faster than high carbon steel, thus the name high-speed steel. When compared to common carbon and tool steels at room temperature and in their generally recommended heat treatment, HSS grades generally exhibit high hardness (above Rockwell hardness 60) and abrasion resistance (generally linked to tungsten and vanadium content frequently used in HSS).

E. Hopper

It is a cylindrical structure which is used to supply the dry leaves into the cutting chamber and also to avoid the splashing of the powder during the cutting operation. It is made out of mild steel sheets.

F. Shaft

The shaft is circular in shape and it is made of EN8 material. EN8 is an unalloyed medium carbon steel which is used in applications where better properties than mild steel are required but where the costs do not justify the purchase of a steel alloy. EN8 can be heat treated to provide a good surface hardness and moderate wear resistance by flame or induction hardening

processes. From the automotive trade to wider general engineering applications, EN8 is a popular steel in industry.

3. Part Drawings

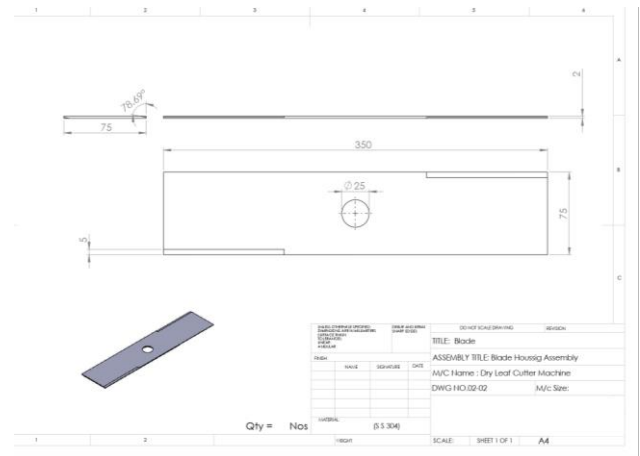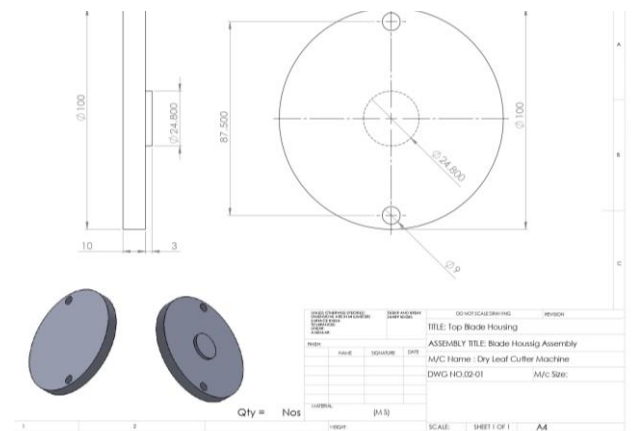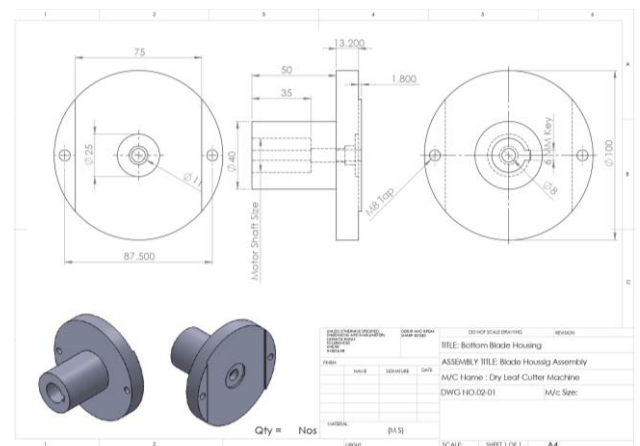Fig. 2. Blade

Fig. 3. Top blade housing
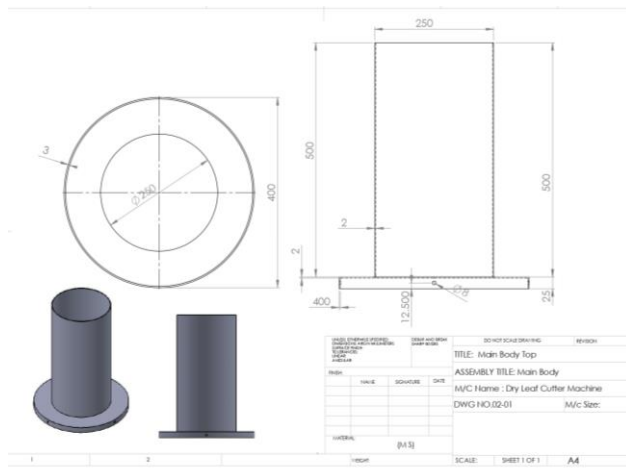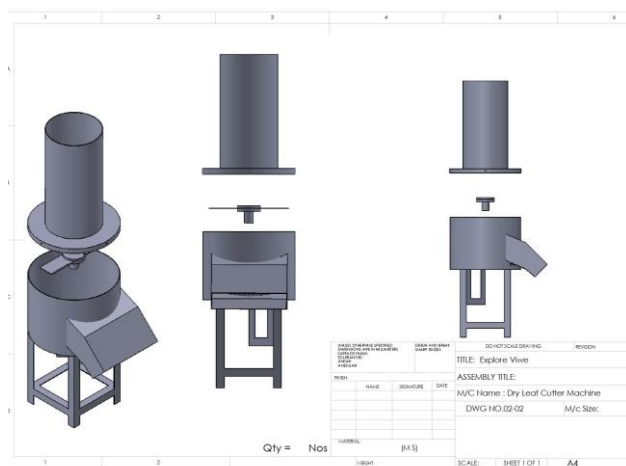

Fig. 4. Bottom blade housing

Fig. 5. Main body top

Fig. 6. Explored view

4. Results

A. Testing of The Machine

The machine was tested to verify the noise and efficiency of the shredder machine. A known mass of dry leaves and twigs is fed into the hopper, and the time required for shredding is recorded. The test was carried out at four different time intervals.

The finished machine was put through its paces. The total amount of powder produced in various time intervals is used to assess performance. The machine can shred 12 kg of dry leaves and small twigs, taking into account factors such as machine setup time and blade assembly jamming. The machine test allows us to better understand its suitability and functionality. The graph below depicts the weight of powder produced (kg) versus time (min).

The fig. 7, depicts the relationship between the weight of powder collected at the bottom of the collector chamber and the time required. The shredding process is repeated four times at different time intervals. The obtained results were used to create the graph. As time passes, the weight of powder collected increases.
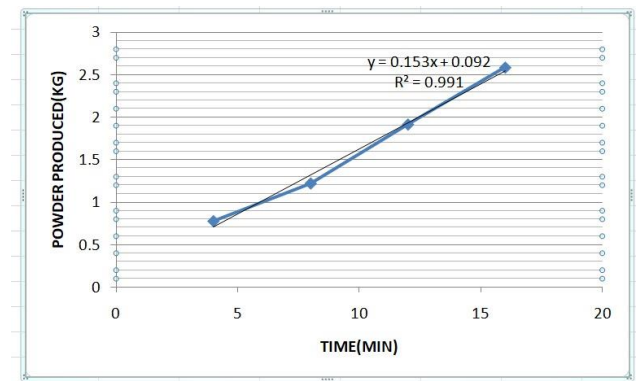

Fig. 7. Powder produced (kg) vs. Time (min)

5. Applications, Advantages and Disadvantages

A. Applications

- They are not only suitable for large scale application but also for the small level agricultural field.
- Coconut leaves can also be converted into small pieces that can be used as a fertilizer for cultivation purpose.
- It can also be used in households to shred the vegetable wastes that can be used as manure for the gardens.

B. Advantages

- Waste shredder machine reduces the amount of agro waste from the farm and make the farm beat and clean.
- It converts the solid wastes which are too hard to decompose and digest to very small pieces and it will decompose easily.
- The agro waste causes so many environmental issues like health hazard. It produces harmful substances such as Sulphur dioxide (SO_2), silicon dioxide ($sio2$) and inhalable particles are emitted into the air in burning straws. That can be prevented in by shredder machine

C. Limitations

- The vibration produced by the machine is the main problem.
- Wet leaves are little bit difficult to powder.
- Hard twigs cannot be powdered.
- Noise produced by the machine is little bit higher.

6. Conclusion

Finally, we can conclude that the machine is intended to be a better option for farmers. And the machine was created by keeping in mind the various needs of farmers. Because it is designed for small-scale applications, the machine does less work. This machine can also be improved and developed for larger crop residue shredding, as it will become an alternative for expensive chemical fertilizer.

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