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Design and Fabrication of Compost Machine

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Abstract: Organic waste and Food waste is a worldwide problem, is cost to be disposed and nothing is gained from it on the contrary, it causes the fission of harmful gas such as methane. Vegetable waste with high moisture content and readily biodegradable nature is causing major environmental problems due to improper waste management practices The Design and Fabrication of Compost Machine in India. So, composting could be considered the best alternative for the treatment of these organic fractions. Composting has proven to be a valid solution to this problem. The objectives of this project are to design a composting machine with certain parameters for the design, Process time, and easy, odourless and power saving. The designed food waste decomposition system is designed for rapid composting performance. It can be used for households, restaurants, hotels, schools, apartment buildings, communities, offices and cafeterias depending on the capacity of the machine. The system employs high temperature to decompose food waste and organic matter. The prototype was able to decompose organic waste in a time frame of 38 to 50 hours with minimum harmful gases emissions and odours.

Keywords: Vegetable waste, decomposition, recycling process, solid waste management.

I. INTRODUCTION

India is the second largest producer of fruits and vegetables in the world (after China) with 241.43million metric tons. In a country like India, waste management and disposal of the waste to be a tedious task where a huge amount of wastes has been generated due to enormous consumption. There also lies an issue in transporting the wastes to the recycling plants, wherein a huge amount of effort, time and money needs to be put in for transporting the wastes which are clustered and are not in uniform shape or size. The waste materials need to be made into a uniform shape for easy and effective transportation. This paper aims in producing a mechanical crusher which would be a helping hand for waste management. The machine has U-shaped composting tank, with a crusher, heater, mixing blades. These materials if carried just like that would occupy more space and would require huge containers and transportation cost becomes an issue. These materials need to be arranged properly to increase the carrying capacity of the vehicle and as the organic waste being an indefinite shape needs to be made into uniform shape and size for easy decomposed. This is where the mechanical crusher comes into play. The crusher would crush the organic waste thus reducing the gap between them and make them to uniform size and shape so that the materials can be baled up according to the size of the crushing bin. The uniform size and shape of the materials can be obtained by providing a bin onto which the material is to be crushed. The crusher is designed to operate by both mechanical and electrical means. This crusher is designed in such a way that it is simple to construct and would require minimum effort for operating in both mechanical and electrical types of operation.

II. LITERATURE REVIEW

A. Vivien Arief Wardhany et.al (2019)

Has studied in their paper named “SMART CHOPPER AND MONITERING SYSTEM FOR COMPOSTING GARBAGE” concluded the results of research and testing that have been carried out, it can be concluded, by combining the technology, we can reduce the garbage pollution by utilize the chopper machine and monitored them. The garbage also can provide the benefit by recycling it into the compost, so it will help the environment by giving the supplement to the soil.

B. Mansi Pare et.al (2019)

Has studied in their paper named “DESIGN OF ORGANIC COMPOST MACHINE “concluded the designed machine is a fully automatic and highly compact composting machine, which uses special microorganisms to break down and decompose all kinds of organic waste into compost within 24 hrs with a volume reduction of 85-90%. The entire process is natural and biological. The outcome of this report is the basic knowledge of working of heavy-duty machines and the criteria behind their working in a brief manner.

C. Mustafa Elalami et.al (2019)

Has studied in their paper named “DESIGN AND TEST OF THE SMART COMPOSTER CONTROLLED BY SENSORS” concluded the design and the realization of a new composter destined to convert the residues food and all type of organic wastes in situ (to eliminate transport charges) to obtain a mature compost with high quality in 4 weeks. This system is based on the intern design and automated and optimized control of all operating parameters. This solution will reduce up to 80% of waste produced per day.

III. PROBLEM STATEMENT

Now a day's most of the farmers are using chemical fertilizers for their crops. Due to this the productivity of crops as well as the fertility of soil is decreasing day by day. Also, the prices of these chemical fertilizers are more to farmers. Thus, it brings to our knowledge that the traditional methods are not sufficient and satisfactory for agriculture. Due to these, some major problems are identified & to over-come these problems some idea or concepts are developed and adopted.

Following are the problems:-

- 1) There is no more scope for organic farming which is required.
- 2) The machines available for preparing organic fertilizers are costly which farmers cannot afford to buy.
- 3) Available machines are operate at high power consumption which indirectly increases the cost.
- 4) Available machines are very bulky.

The aim is to design & develop a low-cost fertilizer preparing machine which will help farmers to fertilize their land by their self-prepared organic fertilizer i.e., compost instead of buying costly and harmful chemical fertilizers which decrease the nutritive value of soil. We are going to design and fabricate such a machine that will eliminate most of the problems of farmers such as high cost of machine, more floor space requirement, high power consumption, requirement of electricity which is not possible in rural areas. So, the machine will be designed & developed to reduce the human effort by introducing proper gearing mechanism, to make use without electricity manually thereby helping to earn more profit to farmers.

IV. DESIGN METHODOLOGY

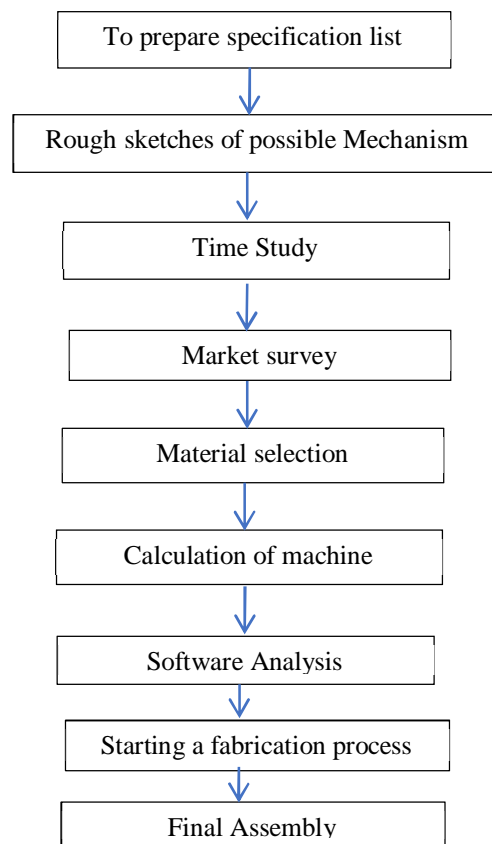


Fig 1. Methodology of Composting Machine.

A. Components for Composting Machine

1) Single Phase Induction Motor



Fig 2. Single Phase Induction Motor

Single Phase Induction Motor is shown in Fig 2. The speed of this motor is 1440rpm with 0.5 Horse Power (HP) work on 230 AC volt supply.

2) Feed Grinder



Fig 3. Feed Grinder

To process livestock feed from grain, farmers often use a type of agricultural machine called a grinder-mixer. A grinder-mixer is a portable mill that combines the mixing and grinding operations. Feed Grinder is basically a receiver which receive the certain amount of waste in it. And with the help of Screw Blade, it crushes the waste into thin particle. The Upper Diameter is 140mm and the throttle diameter is 30mm.

3) Mixing Blade

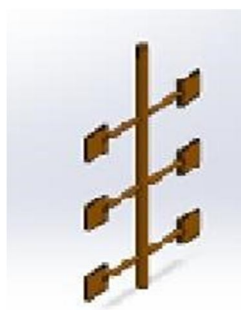


Fig 4. Mixing Blade

It is used to mix the waste properly in the tank. There is 4 mixing blade whose size is 5x2.5 (Inch)

4) *Heater*

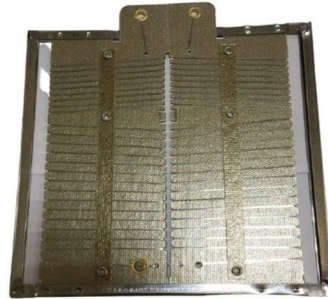


Fig 5. Mica Flat Heater

Flat strip heaters of mica, also called flat mica heaters used for heating waste product after it gets mixed properly to form a final product i.e. Fertilizer. This Heater is of 500watt.

V. DESIGN AND CALCULATION

A. *System Design*

1) *Motor Design*

Voltage = 230 AC/V, Current = 1.6 Amp, Speed = N = 1440 RPM, 0.5HP= 373WATT

Allowable Shear Stress of Shaft Is 100Mpa

$\tau=100\text{Mpa}$

2) *Belt and Pulley*

A Section Type of Belt is Used (A-48)

B Type Pulley

10inch Pulley for Crasher

3inch Pulley for Motor

Torque of Pulley (A)

$$P=2\pi NT/60$$

$$T=2.4\text{Nm}$$

Calculating Allowable Diameter of Shaft at Pulley (A)

$$T=[\frac{\pi d^3}{16}] \tau \dots \text{(for solid Shaft)}$$

$$D1=5\text{mm}$$

Speed at Pulley (B) = 432rpm

Torque of Pulley (B)

$$P=2\pi NT/60$$

$$T=8.24\text{Nm}$$

Calculating Allowable Diameter of Shaft at Pulley (B)

$$T=[\frac{\pi c d^3}{16}] \tau \dots \text{(for solid Shaft)}$$

$$D2=8\text{mm}$$

3) *Hopper*

Upper Diameter = 139.7mm

Mid Diameter = 101.6mm

Lower Diameter = 30mm

4) Tank

Tank Size = 13inch (diameter)

Height (depth) = 12.5inch

Volume of Tank (V) = $\pi r^2 h$

V=1534inch

Capacity= 25litre

5) Frame

Frame Size = 27x28inch

Height = 35inch

6) Heater

500W Mica Flat Heater

Maximum Temperature = 300°C

Following figures shows the designed machine in SOLIDWORKS.

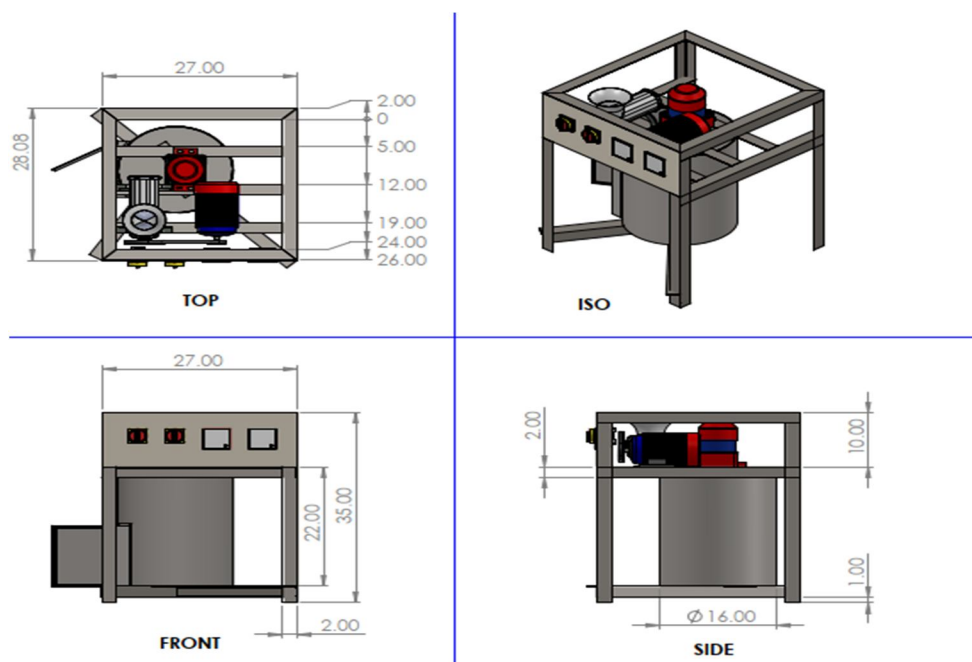


Fig 6. Assembly of Composting Machine

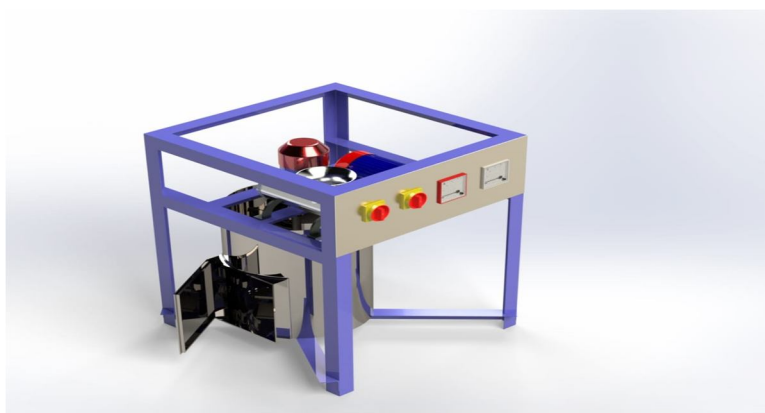


Fig.7: 3D view of compost machine designed in SOLIDWORKS

VI. RESULT

- A Organic wastes will compost fast best if the pieces were small.
- B Soft tissue wastes such as orange don't need to be very small because it will decompose fast.
- C The turning blades are playing the big role in the composting process because it prevents the waste from overheating at some point inside the tank.
- D After the process is completed, all weeds and weed seeds are killed, even insects, that is done by rising the temperature.
- E The use of wood chips has increased the reduction in odors.
- F To have the composting process as effective as possible, the input waste should have an approximate carbon to nitrogen ratio of 30 to1.
- G The process will work best if the moisture level of the input waste is about 50 percent. It is not also easy to measure.

Input	Time	Output
500 gm	1 Day	257 gm
1 kg	1 Day 2 Hours	500 gm
3 kg	1 Day 6 Hours	2.5 kg

VII. CONCLUSION

Proper evaluation of the design is performed and created something even better. Finally, we conclude that fertilizer preparing machine is better option to use by the farmer as its cost is low as compared to other machines. The machine is designed taking into consideration the various demands of farmers & other customers. Since this machine is made for small businessman or for farmers, therefore the work carried out by this machine is less. The capital required for purchasing the bigger size fertilizer preparing machine is very high & also the substitute way of using chemical fertilizers is also very costly. And also, we Study the different factors within the composting process &the effect of bacteria on the composting process.

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