

DESIGN AND FABRICATION OF ORGANIC WASTE COMPOSTING MACHINE

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Abstract :

As India is the most populated country, the increasing population may cause not only decreases the land area but also increases pollution due to dumping of waste. So the organic waste which is dumped is recycled without dumping it in dumpyards. As the organic waste is decomposed by micro organisms in controlled conditions, it takes 30-45days to decompose in traditional way and effects the environment by spreading insects along with odour and gases. This is due to density of waste deposited, high density of waste leads to less rate of decomposition. So this project is going to design and fabricate a mini composting machine with a simple mechanism by using series of stator and rotor blades and a DC motor.

Keywords: organic waste, dumping, decomposition, odour.

INTRODUCTION

Relevance to design practice

Composting is a form of recycling process. Every country is coming forward for recycling of organic waste because 50% Municipal Solid Waste is organic waste. They are looking forward for utilization of dumping area and trying to keep the nearby areas safe from ejected gases. Compost is a type of natural fertilizer with rich nutrients which is formed after the decomposition of organic waste.

Generally composting is done by using green/organic waste, in case of traditional way it takes so many days for microbial decomposition of such waste but modern methods decreases such time due to direct shredding of waste. The shredded waste is rotated with uniform speed by adding water and heat treatment process. The final stage of heat treatment is to prevent the odor and make the waste to store with less moisture and volume. The compost produced is used in small gardens, rooftop farming, etc.,. Compost is not only gives high nutrients to soil but also decreases soil erosion.

Methodology:

To go through the various literatures and knowing about different types of compost bins and processes make us to prepare a design that must be rust free and ease of assembling and disassembling with in the compact size. To prepare a basic design by using 3D model. To fabricate a working proto type by using appropriate models of bin for a Indian kitchen.

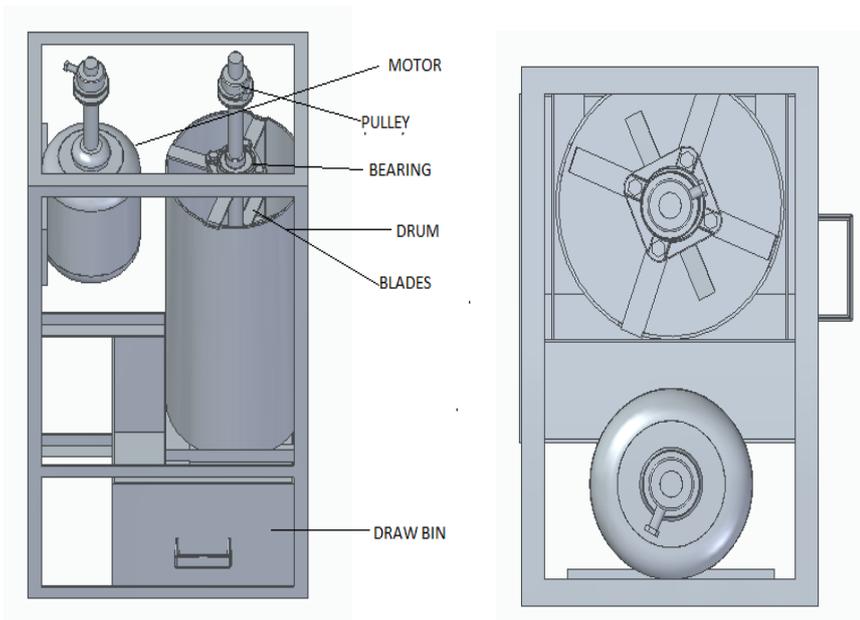
Design considerations:

Input: Vegetable waste is the input to the system. So the design should be corrosion free.

Handling: Handling of waste is easy as it is easily converted in to the compost form.

Location: As the height of the machine is similar to the height of wash basin height. It is easy to dump the waste and easy to chop the vegetable waste during cooking.

Quick procedure: when compared to traditional process, the time taken by this process is less.



SPECIFICATIONS:

PARTS	SPECIFICATIONS
1. MOTOR	1800 RPM
2. SHAFT	61.4*2.54 cm dia
3. BLADES	9cm length 1.5cm width
4. DRUM	50.4cm height 22.8cm dia

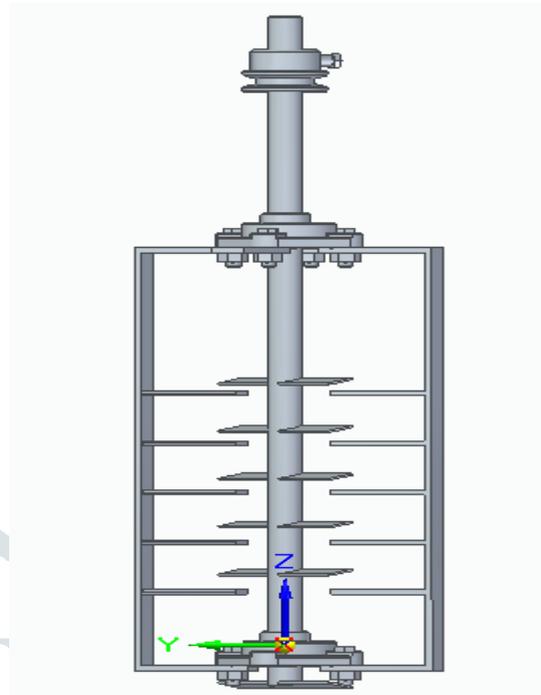
Composting machine model design:



Stator and rotary blades design:

The blade design is simple and it contains stator and rotor (fixed and movable) blades. The stationary blades are at fixed position i.e., blades never get rotated along with the shaft while movable blades rotates with the rotating shaft. This mechanism of stationary and rotatory blades makes the waste to slices (into small pieces).The efficiency of cutting as compared with normal blade designs is high. The blades along with stator and rotor are assembled to the bearing of the shaft by using nut and bolts. This arrangement is mounted on the drum in drum slots. The simple assemble and disassembling of blades and its effectiveness makes this blade mechanism as usable and suitable for modern standard of living. As sharpness of blades are high, there might be a

chance of difficulty during cleaning. To overcome such chance of difficulty the blades set is easily brought out and splashing of water makes it clean.



Hollow shaft:

Since the mass is constant, A hollow shaft is necessarily a result of relocation of material from axis to periphery. This results in decrease of slenderness of the shaft and hence, its torsional rigidity increases.

$$\frac{\tau}{r} = \frac{T}{J} = \frac{G\theta}{L}$$

Where for a solid rod

$$J = \frac{\pi d^4}{32}$$

Torsion

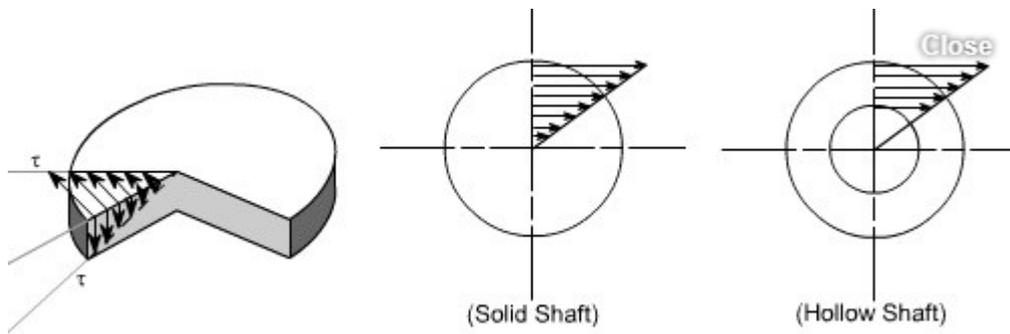


Explanation:

The strength of the shaft implies the maximum torque it can transmit. It depends on Torsional rigidity of shaft since it renders the stiffness to the shaft. Torsional rigidity is defined as the torque required for producing a twist of one radian per unit length of the shaft. And by torsional formula:

$$T/(\theta/L)=GJ=\text{Torsional rigidity}$$

So, Stiffness and hence strength is proportional to J which is by maths, less for solid shaft and by intuition, less for most slender of the two (solid shaft).



- In comparison to a solid shaft, a hollow shaft is of less weight, for a given length and diameter. This is pretty obvious and won't be requiring any further explanation. Moreover it's a good idea to go ahead with hollow shafts, if we our emphasis is on weight reduction and cost-cutting.
- Hollow shafts are much better to take torsional loads compared to solid shafts. As shown in the figure, shear stress in a "shaft subjected to torsion" varies linearly from zero at the center to the maximum at the boundary. Inside a solid shaft, most of the material experiences / carries a shear stress whose value is much below the maximum shear stress [Interior portion of the shaft]. But at the same they are adding to the weight, without contributing much to the capability of the shaft to carry torsional load.

Shear stress at a point in a hollow shaft (τ) is given by , $\tau = \frac{T r}{I_p}$

Where τ = Shear stress in a hollow shaft

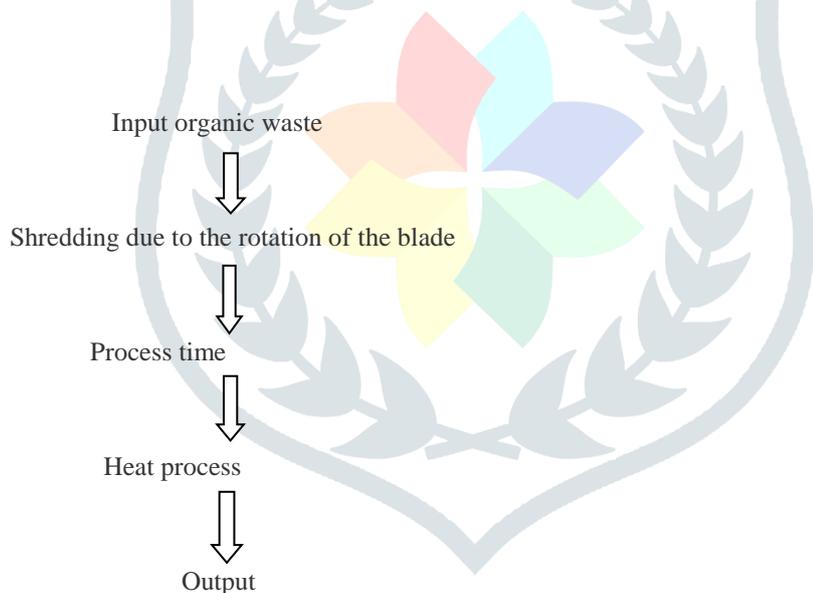
T = Torque in shaft (N-m)

r = radial distance from the center to the point of interest (m)

I_p = Polar area moment of inertia (m⁴)

- Average shear stress $[\frac{\text{Min. Shear stress} + \text{Max. Shear Stress}}{2}]$ in a hollow shaft will be higher compared to a solid shaft and its value is closer to the maximum shear stress.
- Hollow shaft has a greater Strength to weight ratio.

Flow chart:



Composting process:

Initially the machine is switched ON and gradually the input (organic waste) is dropped in it. Due to the speed of the motor the input waste is shredded and converted into paste. That paste is then heated under the heating coil by uniform rotation of blades. For this set up a regulator is placed to control the rotation of blades. Due to heater the moisture in the waste get dried and volume of waste decreased, it is easy to store. As moisture is removed there is no chance of pests (insects) and odor from the waste. when ever required our homemade compost is ready.

Result and Conclusion

The compost bins are eco friendly and economical to gardening. most of companies looking for WTE process. Compost Bins play a major role in solid waste management in Indian in the future by eliminating the organic waste dumping at the source and instead only dumping inorganic waste. As the compost bin is easy to use and is cost effective, many people can buy and use it. It is easy to use and is simple. Composting have great potential to contribute to material recovery, reduction of landfill, use of renewable resources and helps in Solid waste management. The new design of the compost bin is aesthetically good looking can be kept inside kitchen, non-messy, no odor, keeps insects, flies away from compost pile, and keeps the plants in the home healthy.

Future Work

Based on few of the suggestions suggested by the users for future improvements of the compost bins, below are some of the future scope of the compost bin. They are:

- Wheels can be added at the base so that it is easily transportable.
- Blade setup can be made with multiple size for thick and thin vegetables.
- Blade setup can be removable.
- Composting area to be transparent.
- Proper handle for movement of compost bin.
- Mechanism for addition of compost starter and final output compost removal.
- Replacement of motor with the higher torque.
- Increasing the capacity of the heater for effective results.

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