

DESIGN AND DEVELOPMENT OF ORGANIC WASTE COMPOST MACHINE

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ABSTRACT:

India being one of the most populated countries in the world produces huge solid waste every day. The solid waste collected by government services for waste management is around 1.35 lakh metric tons every day. Even though government is taking efforts to keep the country clean, still more than 20 thousand metric tons of waste is not collected through the waste collection channel and hence it is exposed to environment without processing it. The amount of waste exposed to environment is creating severe pollution and resulting in effects on the human health. Authors have developed the machine for management of waste through compost for households. The design details of compost machine are presented in this paper.

KEYWORDS: Organic Waste, Compost, Waste Management, Compost Machine.

INTRODUCTION:

The waste management is one of the basic process to be handled carefully by every country for sustainable development. The statistics of India in waste of food are not even satisfactory as around 20 Crores people go to sleep without meals on the other hand the huge amount of food is wasted due to mismanagement. The waste production from kitchen can be utilized for processing to convert it to compost.

There is double advantage if we convert the organic waste to compost. Amount of waste can be reduced and produced compost may sell at good cost. General process of compost for organic waste is shown in figure below. Waste treatment plants are located at remote places. The waste is collected from household are transported to location of plant. At the processing unit, waste is converted to organic fertilizer which is useful for farms. The conversion of solid waste to useful fertilizer is mainly carried out in composting.

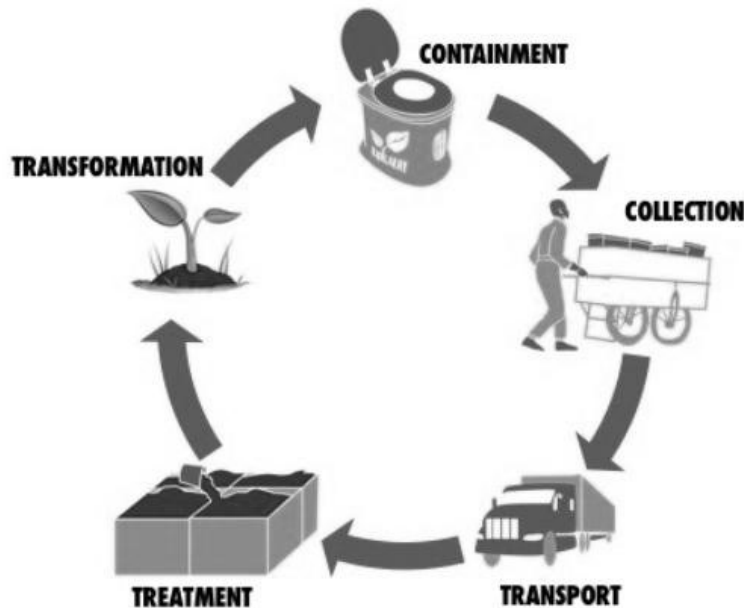


Fig.1: Process of Solid Waste Treatment

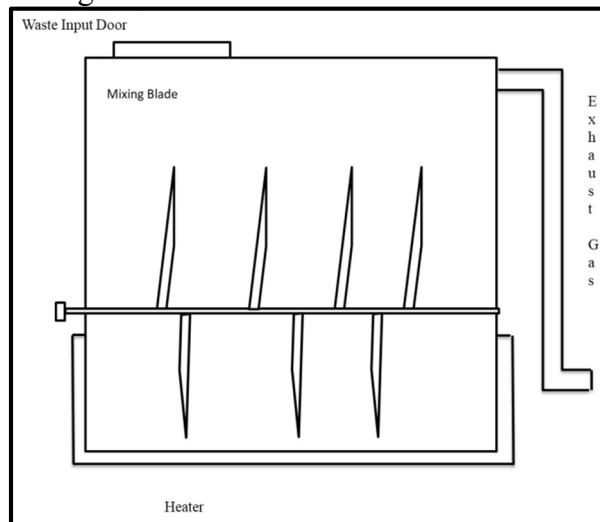


Fig.2: Block Diagram Compost Machine

The basic block diagram of compost machine is shown in figure above. It is observed that, within 24 hours the machine can convert solid waste to organic fertilizer. Microorganisms are used for decomposition of waste. This machine can also be used in individual households due to benefit of low cost and small size. It reduces the volume of waste by amount of 80 to 85%.

MOTIVATION AND OBJECTIVES OF WORK:

The huge amount of waste is produced through daily operations in India. Processing of this waste is very challenging task for government machinery. The main problem is to collect the waste from each house daily. Instead of collecting the waste, transporting it and processing, there should be machine which process the waste at location where it is generated. This helps in reduction of cost for transportation of waste. The machine should have the cost, affordable to middle class and should be small in size as the sizes of houses in Indian cities are also small.

SYSTEM DESIGN:

a. Motor Design:

We are considering small D.C. motor with following Specifications:

Voltage = 12V, Current = 5Amp, Speed = N = 2 RPM

We know,

$$P = V \times I = 12 \times 5 = 60 \text{ Watt}$$

$$P = 2 \times \pi \times N \times T / 60$$

$$60 = 2 \times \pi \times 2 \times T / 60$$

$$T = 286.48 \text{ Nm}$$

This much torque is sufficient to push the waste inside the box.

b. Shaft Design:

Material of Shaft = Mild Steel

Density of Steel = 7860 Kg/m³

Poisson's Ratio = $\mu = 0.31$

Young's Modulus = E = 210 × 1000 MPa

Length of shaft = 250mm

According to torsional rigidity diameter of shaft is given by-

$$D = (584 \times M_t \times L / G \times \theta)^{1/4}$$

$$M_t = 286.48 \text{ Nm} = 286.48 \times 1000 \text{ Nmm}$$

$$G = 79300 \text{ N/mm}^2$$

$$\theta = \pi$$

$$d = 20 \text{ mm}$$

Diameter of Shaft = 20Mm

c. Belt and Pulley

Consider, N = 1400 RPM

Z section type of belt is used

Minimum Pitch circle diameter of pulley = d = 50mm

Speed = N = 1400RPM

$$D = 50 \text{ mm}$$

We know that,

$$\frac{d}{D} = \frac{N}{n}$$

$$\frac{50}{100} = \frac{1400}{n}$$

$$n = 700 \text{ RPM}$$

Let, T1 = Tension on tight side

T2 = Tension on Slack side

$$\frac{T_1}{T_2} = e^{(\mu \times \theta / \sin \beta) c}$$

$$\theta = 180 - 2 \times \alpha$$

$$\alpha = \sin^{-1} (r_1 - r_2 / C)$$

$$\alpha = \sin^{-1} (37.5 - 25 / 150)$$

$$\theta = 160.82 = 2.88 \text{ Rad}$$

$$\beta = 40$$

μ = Coefficient of friction for rubber belt = 0.3

We know that, P = (T1 - T2) × V

$$V = \frac{\pi \times d \times n}{60}$$

$$V = \frac{\pi \times 50 \times 10 - 3 \times 1400}{60}$$

$$V = 3.99 \text{ m/sec}$$

$$\frac{T1}{T2} = 3.99$$

$$T1 = 3.99 T2$$

$$P = (T1 - T2) V$$

$$373 = (3.99 T2 - T2) 3.99$$

$$T2 = 33.17 \text{ N}$$

$$T1 = 132.32 \text{ N}$$

Following figures shows the designed machine in CATIA.

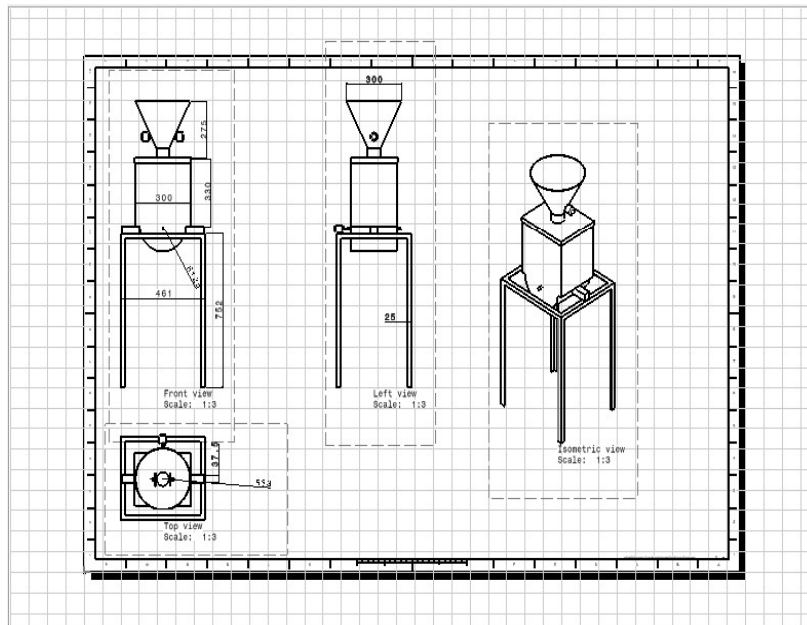


Fig.4: Drafting of Machine in CATIA

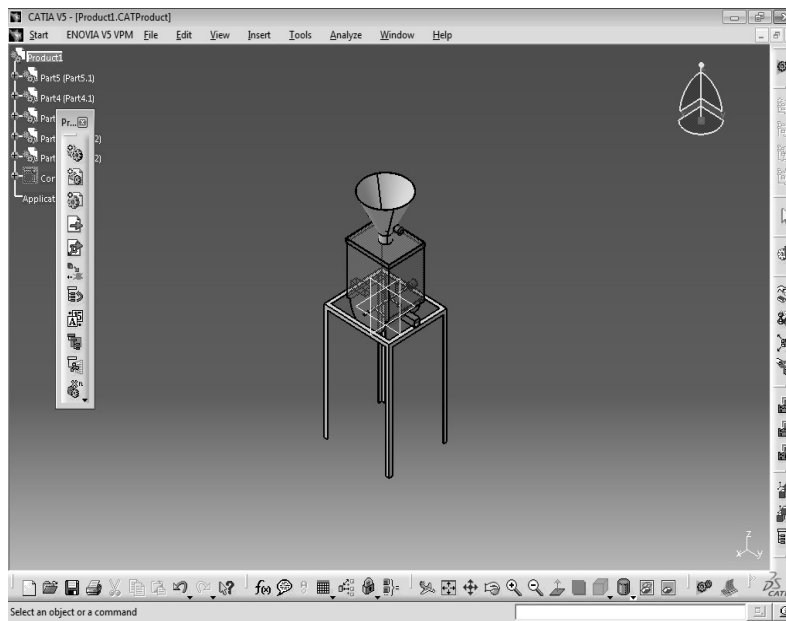


Fig.5: 3D view of compost machine designed in CATIA

CONCLUSION:

Waste management is part of planning for sustainable development. When the produced waste is so huge and spared over Crores of houses, it is very difficult to effectively collect the waste. Any small mismanagement of this waste results in huge loss to environment by means of pollution. Authors have presented the design of machine for waste processing through compost. The developed machine will be suitable for housing societies in India to process the solid waste. This machine will not only results in reduction of economic burden on government but can develop a module for earning of societies through sell of organic fertilizers. These fertilizers are useful for Indian Agriculture sector.

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