



# INNOVATION OF SMALL ORGANIC COMPOST MACHINE FOR WET WASTE MANAGEMENT USING MECHANICAL MECHANISM AND ARDUINO UNO

<sup>1</sup>Mr.Harsh Raipure, <sup>2</sup>Mr.Amit Ganvir, <sup>3</sup>Mr.Ranjit Chauhan, <sup>4</sup>Mr.Suyog Gaikwad, <sup>5</sup>Prof.Tushar Edake

<sup>1234</sup>Student, <sup>5</sup>Professor

Department of Mechanical Engineering  
ISB&M College of Engineering, Pune, India

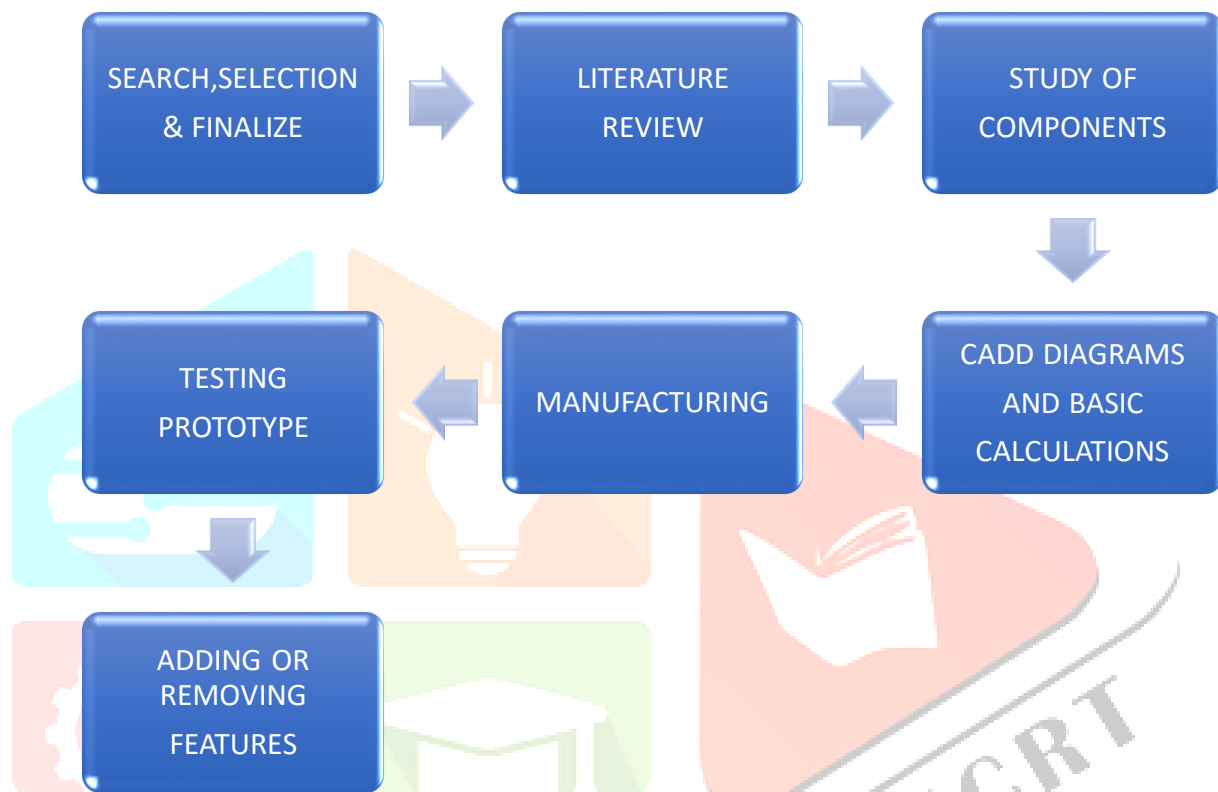
**Abstract:** Every day Metropolitan cities generate more and more waste and this is overloading our municipal systems, systematic management of waste is big problem. Composting is known and easy process of organic waste management. It is a biological conversion self-heating, which generates desired end products such as substrates for cultivation of mushroom, bio-gas and fertilizers. The proper maintenance of temperature and humidity in pulverized organic waste will increase the process of bio-degradation. The study is done to evaluate the performance of compost machine. The proper management of temperature and humidity is important. The aim is to decrease unscientific land filling, segregation of waste and to increase quality of compost or manure

## I. INTRODUCTION

As families and communities search for safe and effective ways to manage kitchen wastes, composting becomes a more attractive management option, this not only restore value to it but also lead to a reduction in the amount of waste that require disposal. Although informal recycling activities of waste materials is wide spread in developing countries, the treatment and use of biodegradable organic fraction, especially for kitchen waste, is still fairly limited. Increasingly, international, and municipal authorities now look at new ways to manage their organic solid waste through the introduction of compost plants (in developing countries) which is an excellent way to avoid wasting useful, natural resources and also avoid creating environmental problems, while at the same time producing a high quality and inexpensive soil amendment (Rynk, 1999). The first industrial station for the transformation of urban organic materials into compost was set up in Austria in the year 1926 (Ellis, 2000). Composting is the biological process of breaking up of organic waste such as kitchen waste, manure, leaves, grass trimmings, worms, and coffee grounds, etc., into an extremely useful humus-like substance by various microorganisms including bacteria, fungi and actinomycetes in the presence of oxygen (Wilson, 2009). Composting is the biological degradation of organic substrates aerobically or an aerobically under conditions of temperature and moisture suitable for acting microorganisms to thrive, with a final product stable for storage and application to soil without adverse environment environmental impact. Composting is the decomposition of organic waste by microorganisms under controlled conditions. Organic waste, which forms a significant part of municipal solid waste, has caused increasing environmental concerns. It is estimated that around 50 percent it can be composted. Instead, most of it is land filled and incinerated. By composting organic waste, we can preserve resources and produce a valuable by-product that can be used as locally produced fertilizer. The existing compost bins have few challenges which are difficult to handle such as messy and smelly compost, time-consuming process (30-45 days), prone to insects and rodents and hard to clean. In addition, some of them release greenhouse gases. Cost issues are there with few automatic and high-end compost bins. This project aims at designing a compost bin for Indian household kitchen, which is easy to use, odour free, ergonomic in nature and visually appealing. In India 101066.27 MT of Municipal Solid Waste (MSW) generated daily according to report of Government of India's Ministry of Urban Development (MoUD). As the cities are expanding fast with vast migration of public from rural to urban areas, the MSW is also increasing day by day. Most part of the waste is used for unscientific land filling or irregular dumping on outskirts of cities, which is the big reason for global warming because the greenhouse gases emit from that landfill. The available MSW management system containing collection, storage, transportation, segregation, and disposal and processing of waste is not up to the level. In relation with MSW management, one of the big problems being faced by towns or cities is that the quantity of solid waste is increasing and government bodies are not capable to modify the facilities require to manage such MSW. A survey is conducted by Natural Environmental Engineering Research Institute (NEERI), Nagpur in 59 cities and predict about 57 000 Tons of MSW generated per day. The efficient method to dispose the organic waste is by composting it to use in agriculture field. Composting is an aerobic process in which microorganisms degrades the organic waste to nitrogen rich manure. Currently

only 9-10% of organic waste generated utilized for composting. Different type of methods are used to convert compost from organic waste by various enterprises and government bodies. The compost quality is depending upon the type of organic waste, procedure of composting, time period etc. In India, the potential of producing organic waste is about 4.4 million tons each year. The main problem in generation of good quality compost is that there is inappropriate MSW management system. The proper sorting of biodegradable and non-biodegradable waste is important to obtain good quality of compost. There are two types of organic waste found in urban areas or cities.

The Composting is beneficial in soil fertility enhancement, stabilizing the environment, decreasing the global warming, improving the waste management system etc. The composting technique reduces the volume of organic waste and kills the pathogens. Also, organic composting converts the ammonia waste to useful nitrogen rich product. The manure when used in soil increases its fertility. For natural organic composting with the help of microorganisms, near about 30-40 days required. The segregation is required for natural organic composting but the desirable conditions obtain for micro-organisms to degrade the waste then there will be less time requires for producing organic compost.



## II. OBJECTIVE

- To study and develop the organic waste treatment machine where different types of organic waste are gets converted into the hand able form.
- To reduce the time required for composting.
- To design and develop the prototype with the help of CATIA V5 R20 software.
- To select the components and materials accordingly after doing the calculations.
- Manufacturing of small Organic Compost Machine.

## III. PROBLEM STATEMENT

Now a day management of waste is the biggest task and factor that the city or metropolis settlements are facing. Around that organic waste handling is very tedious process and need various equipment to successfully dispose the waste. There is a need of an hour that the organic waste must be treated with care and as soon as possible, as it leaves harmful gases, smell due to the bacterial reactions. In this project we are developing the system which can handle and treat the organic waste.

## IV. METHODOLOGY

### V. DESIGN CALCULATIONS

#### 5.1 Motor Design

DC motors have the advantage of: higher starting torque, quick starting and stopping, reversing, variable speeds with voltage input and they are easier and cheaper to control than AC.

Hence, we are selecting the D.C. motor as, the system requirement is to have more starting torque and to minimize the product cost and optimize the system. We are considering the D.C. motor having following Specifications:

Voltage = 12V,

Current = 5Amp,

Speed = N = 2 RPM

We know,  $P = V \cdot I = 12 \cdot 2 = 24$  Watt

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

$60 = 2 \cdot \pi \cdot 5.5 \cdot T / 60$

$T = 41.6$  Nm

This amount of torque is suitable for the organic waste, as our aim is to just push that waste inside the box at low speed, located at its bottom side for further processing.

## 5.2 Shaft Design

Application of our shaft is just to rotate the organic waste inside the box so that the, processing on it can be done uniformly.

Mild steel contains approximately 0.05–0.25% carbon making it malleable and ductile.

Mild steel has a relatively low tensile strength, but it is cheap and easy to form; surface hardness can be increased.

So, we select M.S. as the material for shaft.

Density of Steel = 7860 Kg/m<sup>3</sup>

Poisson's Ratio =  $\mu = 0.31$

Young's Modulus =  $E = 210 \cdot 1000$ MPa

Length of shaft = 300mm----(The required length of shaft)

According to torsional rigidity

diameter of shaft is given by

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

$M_t = 41.6$  Nm

$G = 78000$  N/mm<sup>2</sup>

$\theta =$  For 0.3m=1 degree

$d = 17$  mm

Diameter of Shaft = 18 mm standard available.

## VI. PARAMETERS EFFECTING PERFORMANCE OF COMPOSTING

There are a wide range of parameters which can be used to monitor physical, chemical, biological, and biochemical variations during composting, such as the aeration rate, temperature, pH, moisture content, carbon/nitrogen (C/N) ratio, respiration, enzyme activity, microbial colony, and bioassay.

### 6.3.1 Temperature

Temperature is an important factor for evacuating composting efficiency. It can affect microbial metabolism, population dynamics (e.g., composition and density) of microbes and diversity of microorganisms, and thus can be considered as a promising index of microbial activities and bio-oxidative stages. Godden et al. suggested three distinct stages during composting, including the (a) mesophilic (below 40°C), (b) thermophilic (above 40°C), and (c) cooling (ambient temperature) stage

### 6.3.2 pH

Another important environmental factor is the pH value of composting materials. The presence of short chain organic acids in raw materials, mainly lactic and acetic acids, leads to low pH of MSW, with the value normally ranging between 4.5 and 6. The degradation of organic waste increases the concentrations of organic acids which are intermediate by-products of microbial breakdown of easily degraded substrates such as sugars, fats, starch, and greases during the initial phase of composting. Low pH as a result of organic acids most of the time inhibits progress of composting process.

### 6.3.3 C/N ratio

The C/N ratio is one of the most important parameters to control the composting process and to determine the feedstock recipe and the degree of maturity of the end product of compost. Guo et al. found that the major factors in composting process are aeration rate and C/N ratio. The nutrient that has received the most attention in composting systems is nitrogen since it is the most needed element for plant nutrition. Moreover, it has often been recognized as a limiting factor for microbial growth and activity during the decomposition of plant residues especially in materials with a high C/N ratio.

### 6.3.4 Moisture content

Microbial activity and the physical structure in the composting process can be affected by moisture content; also, it has a central influence on the biodegradation of organic materials. Moisture content is one of the critical design and operating parameters used in compost engineering systems. It is important to transport dissolved nutrients required for the physiological and metabolic activities of microorganisms. Moisture works as a medium to transfer dissolved gas and nutrients absorbed through the cell membrane of microorganisms. The water during composting is produced as a by-product of microbial activities; also, the generated heat through degradation will dry up part of the moisture. The moisture content can be adjusted by blending of components or by adding water.

### 6.3.5 Aeration rate

The aeration rate is the one of most important parameters for the composting process. The main purposes of air supply to composting are to provide oxygen for biological degradation, dry up the wet materials and remove excess moisture, and to carry off exhaust gas and generated heat. Air flow influences spatial.

## VII. RESULT

- Torque required by motor,  $T= 41.6 \text{ Nm}$
- Power required,  $P= 24 \text{ Watt}$
- Voltage required,  $V= 12 \text{ Volts}$
- Diameter of shaft,  $d= 18\text{mm}$

## VIII. 3D MODEL IN CATIA

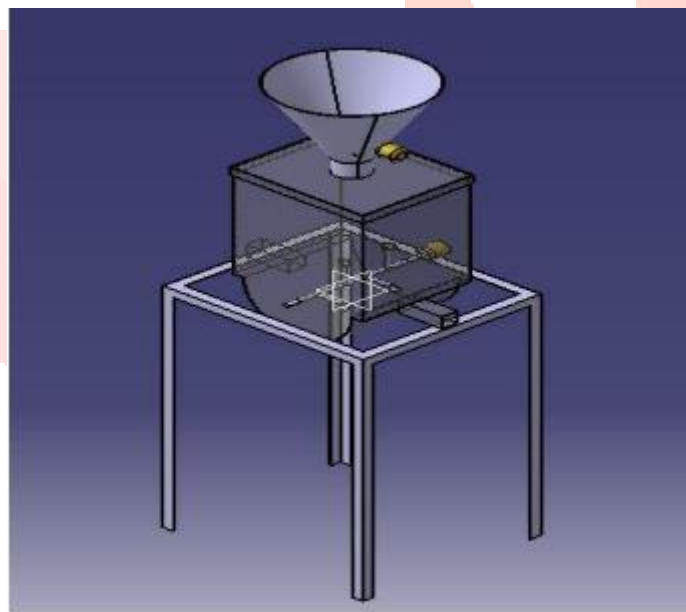


Fig5.4.1 Catia Design: CATIA 3-D diagram of Organic Compost Machine

## IX. CONCLUSION

The behavior of generating garbage is too dangerous not only for today's generation, but also for future generations. It is critical to educate people and encourage them to practice Recycle, Reuse, and Reduce instead of producing waste. For that purpose, we fabricated the model of wet waste management.

## X. REFERENCES

- Pune's Trash Solution: A Zero Waste City (by Kunal Kumar, Municipal Commissioner Pune Municipal Corporation) <https://www.slideshare.net/PlanComIndia/na-oss2-kunalkumar29062015>
- Design, Development and Evaluation of a Small Scale Kitchen Waste Composting Machine Ijagbemi Christiana.Oa , Adepo S. Olusegun [http://iosrjen.org/Papers/vol4\\_issue4%20\(part-6\)/E04462933.pdf](http://iosrjen.org/Papers/vol4_issue4%20(part-6)/E04462933.pdf)
- Design and Development of Compost Bin for Indian Kitchen by Sachin Jayaprakash, Lohit HS and Abhilash BS <https://www.walshmedicalmedia.com/open-access/design-and-development-of-compost-binfor-indian-kitchen-2252-5211-1000323.pdf>
- Design & Fabrication of Portable Organic Waste Chopping Machine to Obtain Compost " by Ajinkya S. Hande [https://www.academia.edu/19834003/Design\\_and\\_Fabrication\\_of\\_Portable\\_Organic\\_Waste\\_Chopping\\_Machine\\_to\\_Obtain\\_Compost](https://www.academia.edu/19834003/Design_and_Fabrication_of_Portable_Organic_Waste_Chopping_Machine_to_Obtain_Compost)
- Design and Fabrication of In-Vessel Composting Machine for Food Waste by Shaifatulna'im Shamsuddin, MohdAsyraf Md Junos <https://myjurnal.mohe.gov.my/public/article-view.php?id=117978>
- Evaluation of Kitchen Waste Composting and its Comparison with Compost Prepared from Municipal Solid Waste by Sajjad Haydar and Junaid Masood [http://www.hpccc.gov.in/PDF/Solid\\_Waste/Kitchen%20Waste%20Composting.pdf](http://www.hpccc.gov.in/PDF/Solid_Waste/Kitchen%20Waste%20Composting.pdf)
- Design and Fabrication of Organic Waste Shredding Machine by Pavankumar S B, Sachin K R [https://www.ijesi.org/papers/Vol\(7\)i6/Version-3/F0706032631.pdf](https://www.ijesi.org/papers/Vol(7)i6/Version-3/F0706032631.pdf)
- Parameters Effecting Performance of Composting [https://www.sciencedirect.com/topics/engineering/composting-process#:~:text=Four%20main%20factors%20control%20the,temperature%20and%20oxygen%20\(aeration\)](https://www.sciencedirect.com/topics/engineering/composting-process#:~:text=Four%20main%20factors%20control%20the,temperature%20and%20oxygen%20(aeration))

