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# DESIGN & FABRICATION OF ORGANIC WASTE COMPOSTING MACHINE

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**Abstract:** This work studied on the composting process of organic waste. Organic waste is the easily biodegradable waste. Organic wastes are produced from many sources Such as agricultural waste, market waste, kitchen waste, urban solid waste and municipal solid waste. Without proper management, this waste could create several environments problem. Therefore, composting is the best low-cost alternative solution to overcome this problem. The composting method can degrade all types of organic waste such as fruits, vegetables, plants, yard waste and others. The organic waste composition can be used as nutrients for crops, soil additives and for environmental management. In this project, the time for the composting process with the help of composting machine is reduced significantly. The hotel food waste is recycled as a fertilizer in order to use it in organic farming.

## 1. INTRODUCTION

It consists of brief discussion about vegetables waste problems, treatment through different composting techniques and combination of waste material during composting process. In India 101066.27 MT of Municipal Solid Waste (MSW) generated daily according to report of Governmentof India's Ministry of Urban Development. 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 landfilling or irregular dumping on outskirts of cities, which is the big reason forglobal warming because the green-house 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 thequantity of solid waste is increasing and government bodies are not capable to modify he facilities require to manage such MSW. A survey is conducted by Natural Environmental EngineeringResearch 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 is 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.

| | |
|---|---|
| Green waste | Fruit peels, chopped vegetables remains, food, leaves etc. |
| Animal waste | Bones, inedible fats, tissues etc. |

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 micro-organisms, 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.

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## 2. LITERATURE SURVEY

**"Compost turner and windrow forming machine" by Herbert T. Cobey United States Patent Office.**
A mobile apparatus for straddling ground-deposited material, such as compost, and provided with a power-driven rotatable throwing member which engages and fragments the material and transfers it through a passage way in the apparatus so that it is discharged and redeposited in a desired windrow formation. In the commercial production of rotted manures or compost, the raw materials are collected from livestock farms or other producers and delivered, usually by truck, to a large plot of land or other open area, where the material is deposited. The raw material, for example raw manure, must be maintained in a compact, moist mass, which is turned periodically during a three- or four- week period so that the entire mass is uniformly decomposed. In utilizing the apparatus which has heretofore been described, the operator brings the front end of the apparatus into close proximity to the back end of a dump truck which is delivering the raw compost material. The forward Wings have been lowered to their ground-engaging position, and the drum is simultaneously lowered. When the wings and are in their ground-engaging position, the elevation of the drum will be such that the teeth will likewise engage or be proximate to ground level. The width between the forward edges of the wings is then adjusted by means of the hydraulic cylinder so that the forward wings will straddle the dumping end of the delivery truck. As previously described, the wings are positioned outboard of the ends of the drum, which may have a nominal diameter of approximately 3 feet and a length of approximately 10 feet. Thus, the spread or distance between the pair of wings is substantial and may be adjusted from approximately 10 feet to approximately feet. The wings may project forwardly of the periphery of the drum for a distance of approximately 5 or 6 feet, and the rear wings may project.

**"A Review Study on Municipal Organic Waste Composting" by Vivek Saini, Sankalp Gupta, Roopendra kr. Verma, Balvindra Singh.**
This paper reviews the utilization of municipal organic waste for composting. Production of municipal waste continues to rise, which causes loss of resources and increased environmental risks. By open dumping and land filling will cause environmental degradation and harmful disease. Composting is the most appropriate economical solution to overcome the problem due to municipal waste. The total waste generated in India is 1.54 lakh metric tonne per day in which 50% of total waste is organic wastes, composting has emerged as one of the best methods for treatment of wastes. Composting reduces the volume of waste generated as well as provide nutrients for plants, also helps in segregation of waste at source. In term of the factor affecting the composting process, temperature, pH, moisture contents and carbon nitrogen ratio are the main factors that contribute to the efficiency of the composting process. This paper shows information on the composting for treating waste as a means of pointing the environmental pollution concerns. Adding additives to the compost have also received much attention in recent years as they enhance the rate of degradation. on the study it can be conclude that composting is the best way to reduced or recycle the municipal waste and it causes less pollution and more beneficial to the environment as well as to the economy when compared to current methods of waste disposal into open dumps.

**"Organic Waste in Composting: A brief review" by Suhas S. Gonawala, and Hemali Jardosh**
This work studied on the composting process of organic waste. Organic waste is the easily biodegradable waste. Organic wastes are produced from many sources Such as agricultural waste, market waste, kitchen waste, urban solid waste and municipal solid waste. Without proper management, this waste could create several environments problem. Therefore, composting is the best low-cost alternative solution to overcome this problem. The composting method can degrade all types of organic waste such as fruits, vegetables, plants, yard waste and others. The organic waste composition can be used as nutrients for crops, soil additives and for environmental management. However, many factors can contribute to the quality of compost products since different types of organic waste have different concentrations of nutrients, Nitrogen, Phosphorus and Potassium (N, P, K) that are the common macro energetics present in fertilizers. The presence of heavy metals shows how Composts can be applied to soils without contributing any negative effects. In terms of the factor affecting the composting process, temperature, pH, moisture content and carbon nitrogen ratio (C: N) are the main parameters that contribute to the efficiency of the composting process. Because the large amount of organic waste in the environment has become one of the main global problems. Among the various treatments in the management of organic waste such as the use of landfills and incineration, the decomposition of organic waste through the use of biological processes is considered more appropriate method of solution. Composting is one of the low cost biological decomposition process. The composting process is circuited by microbial activity. The physical-chemical parameters affected by this process include temperature, aeration, and moisture content, C: N ratio and pH. Composting is an alternative solid waste management system (SWM), it can be used to recycling of organic materials into useful products. In addition, it can also be used to control the increase in waste. This process is considered the most efficient, environmentally safe and as agronomically as possible, where the compost can be used as a soil conditioner, organic fertilizer also as it contains high nutrients for the soil. The microbial community in compost, which are bacteria, fungi and worms can also stabilize the degradable organic matters.

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**"Design and Development of Agricultural Waste Shredder Machine" by I.M. Sanjay Kumar and DR. T.R. Hemanth Kumar**

The article begins by highlighting the traditional methods of agro-waste disposal, which often lead to environmental pollution and inefficient decomposition. The authors emphasize the need for innovative technologies to convert agricultural waste into useful fertilizer. The specific focus of this study is on coconut palm cultivation, a major livelihood for farmers in Kerala and Karnataka, where a significant quantity of agricultural waste remains unutilized due to storage and management difficulties. The literature review section provides an overview of previous research and projects related to agricultural waste management and shredding machines. The authors discuss various methodologies, such as human-powered flywheel motor, portable organic waste chopping machine, areca fiber extraction machine, and waste shredder machine. These studies serve as a foundation for the design and development of the agricultural waste shredder machine proposed in this research. The paper then delves into the scope of the shredder machine, considering factors such as labor-intensive processes, high costs of existing machines, and safety considerations. The authors provide a flow chart illustrating the assembly procedure of the shredder machine, highlighting the key components involved, including the motor, bearings, shaft, cutter, frame, hopper, and spur gear. Detailed design calculations, including cutting force, bending moment, torque, and stress analysis, are also presented, ensuring the machine's structural integrity.

## 3. WORKING SYSTEM

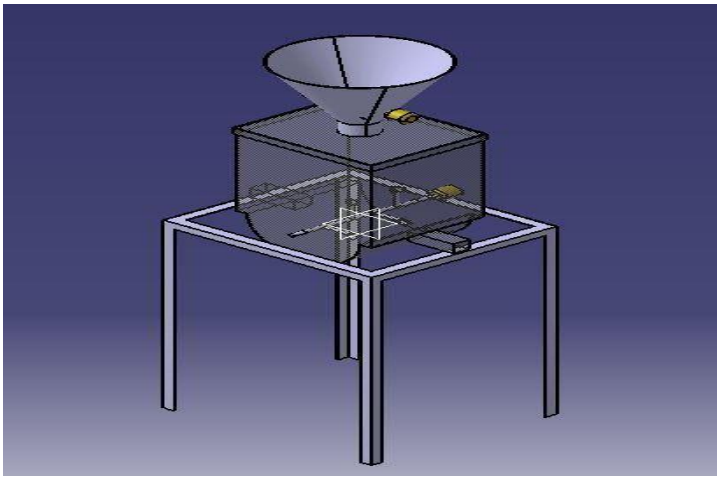
With manual drafting, you use drawing tools that include pencils, scales, compasses, parallel rules, templates, and erasers. Repetitive drawing and editing tasks must be done manually. In CAD, you can choose from a variety of drawing tools that create lines, circles, spline curves, and more. You can easily move, copy, offset, rotate, and mirror objects. You can also copy objects between open drawings. With manual drafting, you must draw objects carefully to ensure correct size and alignment. Objects drawn to scale must be manually verified and dimensioned. With CAD, you can use several methods to obtain exact dimensions. The simplest method is to locate points by snapping to an interval on a rectangular grid. Another method is to specify exact coordinates. Coordinates specify a drawing location by indicating a point along an X and Y axis or a distance and angle from another point. With object snaps, you can snap to locations on existing objects, such as an endpoint of an arc, the midpoint of a line, or the center point of a circle. With polar tracking, you can snap to previously set angles and specify distances along those angles. Revisions are a part of any drawing project. Whether you work on paper or with CAD, you will need to modify your drawing in some way. On paper, you must erase and redraw to make revisions to your drawing manually. CAD eliminates tedious manual editing by providing a variety of editing tools. If you need to copy all or part of an object, you don't have to redraw it. If you need to remove an object, you can erase it with a few clicks of the mouse. And if you make an error, you can quickly undo your actions. Once you draw an object, you never need to redraw it.

To work efficiently using the cad the organization must focus on the following areas where it needs to be on upper side.

- Most popular CAD software like AutoCad, ProgeCAD, Microstation are high priced forindividuals.

Alternatively, individuals can try free opensource CAD drafting software QCAD, LibreCAD and OpenSCAD.

- Every new release of the CAD software, operator has to update their skills.
- Improper use of blocks and layers make updating and modification of the drawings acumbersome task for another person.



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**Geometric dimensioning and tolerance:**

Geometric dimensioning and tolerance (GD&T) is a system for defining and communicating engineering tolerances. It uses a symbolic language on engineering drawings and computer-generated three-dimensional solid models that explicitly describe nominal geometry and its allowable variation. It tells the manufacturing staff and machines what degree of accuracy and precision is needed on each controlled feature of the part. GD&T is used to define the nominal (theoretically perfect) geometry of parts and assemblies, to define the allowable variation in form and possible size of individual features, and to define the allowable variation between features.

There are several standards available worldwide that describe the symbols and define the rules used in GD&T. One such standard is American Society of Mechanical Engineers (ASME) Y14.5. This article is based on that standard, but other standards, such as those from the International Organization for Standardization (ISO), may vary slightly. The Y14.5 standard has the advantage of providing a fairly complete set of standards for GD&T in one document. The ISO standards, in comparison, typically only address a single topic at a time. There are separate standards that provide the details for each of the major symbols and topics below (e.g., position, flatness, profile, etc.)

- In the early days of CAD, exchange-only lines, texts and symbols were written into the exchange file. A receiving system could display them on the screen or print them out, but only a human could interpret them.

- GD&T presentation: On a next higher level the presentation information is enhanced by grouping them together into callouts for a particular purpose, e.g. a datum feature callout anda datum reference frame. And there is also the information which of the curves in the file areleader, projection or dimension curves and which are used to form the shape of a product.

- GD&T representation: Unlike GD&T presentation, the GD&T representation does not deal with how the information is presented to the user but only deals with which element of a shape of a product has which GD&T characteristic. A system supporting GD&T representation may display GD&T information in some tree and other dialogs and allow theuser to directly select and highlight the corresponding feature on the shape of the product, 2D and 3D.

- Ideally both GD&T presentation and representation are available in the exchange file and areassociated with each other. Then a receiving system can allow a user to select a GD&T calloutand get the corresponding feature highlighted on the shape of the product.

- An enhancement of GD&T representation is defining a formal language for GD&T (similarto a programming language) which also has built-in rules and restrictions for the proper GD&T usage. This is still a research area (see below reference to McCaleb and ISO 10303-1666).

- GD&T validation: Based on GD&T representation data (but not on GD&T presentation) andthe shape of a product in some useful format (e.g. a boundary representation), it is possible to validate the completeness and consistency of the GD&T information. The software tool FBTol from the Kansas City Plant is probably the first one in this area.

- GD&T representation information can also be used for the software assisted manufacturing planning and cost calculation of parts. See ISO 10303-224 and 238 below

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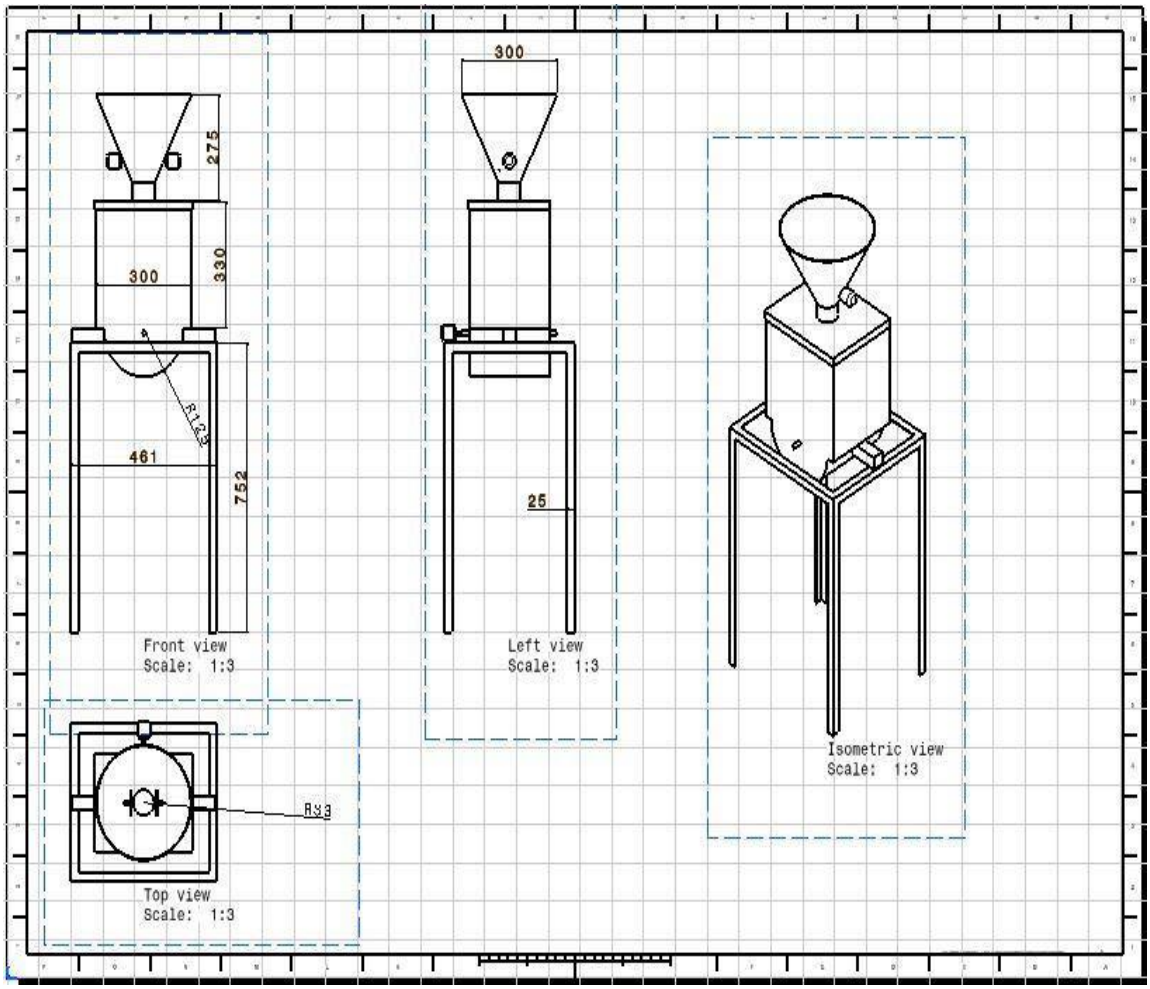


**Working Of System:**

The organic compost machine is used to degrade the organic waste such as food and garden waste to nitrogen rich organic manure or compost quickly. The temperature and moisture required for degradation of waste with the help of microbial is about 66˚C and 60% respectively.

In this machine the organic waste volume is lowered with the help of shredder which pulverizes it. The proper management of temperature and moisture content decreases the time period required for composting. Due to which the segregation and improper land filling is restricted.

## 4. CALCULATION

### 4.1 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 torqueand 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*I = 12*2 = 24 Watt
P = 2*π*N*T/60 60 = 2*π*5.5*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.

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**4.2 Shaft Design:**

Material of Shaft = Mild Steel (Design Data Book-V.B. Bhandari- Application of our shaft is just to rotate the organic waste inside the box so that the, processing on itcan 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/$m^3$Poisson's Ratio = $\mu$ = 0.31

Youngs Modulus = E = 210*1000MPa

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

According to torsional rigidity diameter of shaft is given by-

$D = (584*M_t*L/G*\theta)^{1/4}$ …. (Design Data Book-V.B. Bhandari Page No. 9.7)$M_t$ = 41.6 Nm

G = 78000 $N/mm^2$ …. (For steel shafts-Design Data Book-V.B. Bhandari Page No. 9.7)ɵ = For 0.3m=1 degree …. (For steel shafts-Design Data Book-V.B. Bhandari Page No. 9.7)

d = 17 mm

Diameter of Shaft = 18 mm standard available.

**4.3 Storage Capacity for Rectangular Tank:**

Now let us consider the dimensions of rectangular tank as follows for the calculation of Maximum amount of food waste it can handle. Here we know the maximum upper limit limit of our prototype which is 30 kg. So accordingly, we have selected the dimensions of rectangular tank.

While considering the dimensions we have taken care that the height of tank must be maximum so that maximum waste can be putted in the tank in vertical manner. The purpose is that, the waste canbe mixed properly and heat can be properly applied to it.

So accordingly, we have taken,Length = 12 inches

Width = 12 inchesHeight = 7 inches

Capacity (Cubic Inches) = Length x Width x HeightCapacity (Cubic Inches) = 12 x 12x 7

Capacity (Cubic Inches) =847 Cubic Inches We know that, 231 cubic inch= 1 US gallon.

Capacity= Capacity in cubic inches / 231

Capacity= 847/231Capacity (Gallons) = 3.6 Gallons

Again, we know that, 1 US gallon of water (gal) = 3.79 kilograms of water (kg wt.)Capacity = 3.6 x 3.79

Capacity = 13.8 kg food waste

This calculated weight is of 100% wet form of waste, but organic waste is made up of dry and wetform

Maximum food waste we can Organic Compost is 5 kg

## 5. CONCLUSIONS AND FUTURE SCOPE

**Conclusion:**

Composting is a method that respects the environment instead of pouring waste directly into the soil. It is useful method for converting organic waste into useful products that would otherwise have been filled on land. Food waste composting machines helps to enrich the soil and retain the moisture which decreases plant diseases. Compost has many benefits such as: reducing landfill space, reducing surface and groundwater contamination, reduce methane emissions, reduce transport costs, reduce air pollution by burning waste, provide a more flexible global waste management, improve the recycling of materials and can be carried out with little capital and operating costs.

**Future Scope:**

Rising consumer awareness about benefit of organic product is expected to increase the demand for these machines in next few years. Consumers use compost as natural fertilizer which is required for organic farming to produce chemical free fruit and vegetables. This turns in expected to drive the market for the machines in Asia pacific during the forecast period.

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