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

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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 micro-organisms 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 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 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.

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 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.
- To encourage the management of waste using composting methods.

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.

- Need of an hour that the organic waste must be treated with care and as soon aspossible, as it leaves harmful gases, smell due to the bacterial reactions.
- Need to treat the organic waste so as to reduce the adverse and harmful effects it maycause to the environment and the society.
- Choosing the most convenient method of organic waste treatment – Composting invarious other options such as Land fill, Vermi-compost, Incineration, Animal feed.
- Developing the system which can handle and treat the organic waste.
- Design and manufacture an Organic Waste Compost Machine for the treatment oforganic waste such as –

- Vegetable Peels
- Food Leftovers
- Garden Waste
- Meat & Egg Waste

IV.LITERATURE SURVEYS

Design, Development and Evaluation of a Small-Scale Kitchen WasteComposting Machine", 2014

by Ijagbemi Christiana.O, Adepo S. Olusegun

The huge cost incurred in the packing and transportation of domestic waste in Nigeria accounts for not less than 60% of the total budget for waste management. The design of a cost effective composting machine for small-scale production of manure (compost) from kitchen wastes is achieved. Actual efficiency of 64.09% was recorded as compared to the theoretical efficiency of 80%. The composting machine consists of a composting drum made from galvanized steel, and is enclosed by an outer cylinder mounted directly on a frame. A feeding

hopper enters from outside through the cylindrical enclosure into the composting drum. The cylinders, both inner and outer, are designed together such that there is a vacuum between them. The outer cylinder bears a box together such that there is a vacuum between them. The outer cylinder bears a box on one of its sides. This box houses a heating coil and a fan mounted just behind it. Perforations are created through the outer cylinder on the side which is attached to the box. Heat is produced by an electrically controlled heating coil, regulated by a thermostat, which warms up the air in the box, together with air coming from outside through an opening created at the back of the box.

Based on the design, and fabrication of an effective composting machine for small-scale agricultural processes is achievable using local content materials and indigenous technology. The efficiency of the machine is at a value above average, further research can be carried out to improve the existing design. Furthermore, the design aim and objectives were achieved. The machine can thus be said to have appropriate technology for efficiency in output, and if further research is carried out on the study, the quantity of output and time of operation can be improved upon. With the machine, composting time and cost of purchasing manure will besaved on a long-term basis, while agricultural practices and machine fabrications using indigenous technology will be encouraged.

"Design and Development of Compost Bin for Indian Kitchen", 2018

by Sachin Jayaprakash, Lohit HS and Abhilash BS

Quality function deployment is a tool used to transform user demands into technical voices for delivering better design. This is mainly done using Quality Function Deployment matrix. QFD has a major role in deciding the product design specification as the importance of features will be decided in this. Features to be incorporated are decided based on priorities. Floor space area, Compartments, Portable, Ease of use, Attractive, Less cost, Maintenance, Lightweight, Durable are the major customer requirements plotted. These were marked against technical voices like Mechanism, Weight, Performance, Material, Ergonomics, Feature, Shape, Size, Aesthetics and Capacity. Customer rated Ease of use as the important requirement. The technical requirement, which is important, is weight, ergonomics and mechanism.

Compost Bins play a major role in solid waste management in India 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. It has 2 rechargeable batteries which can be recharged oncea day or 2. 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 ofthe 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.

" Design & Fabrication of Portable Organic Waste Chopping Machineto Obtain Compost ", 2015

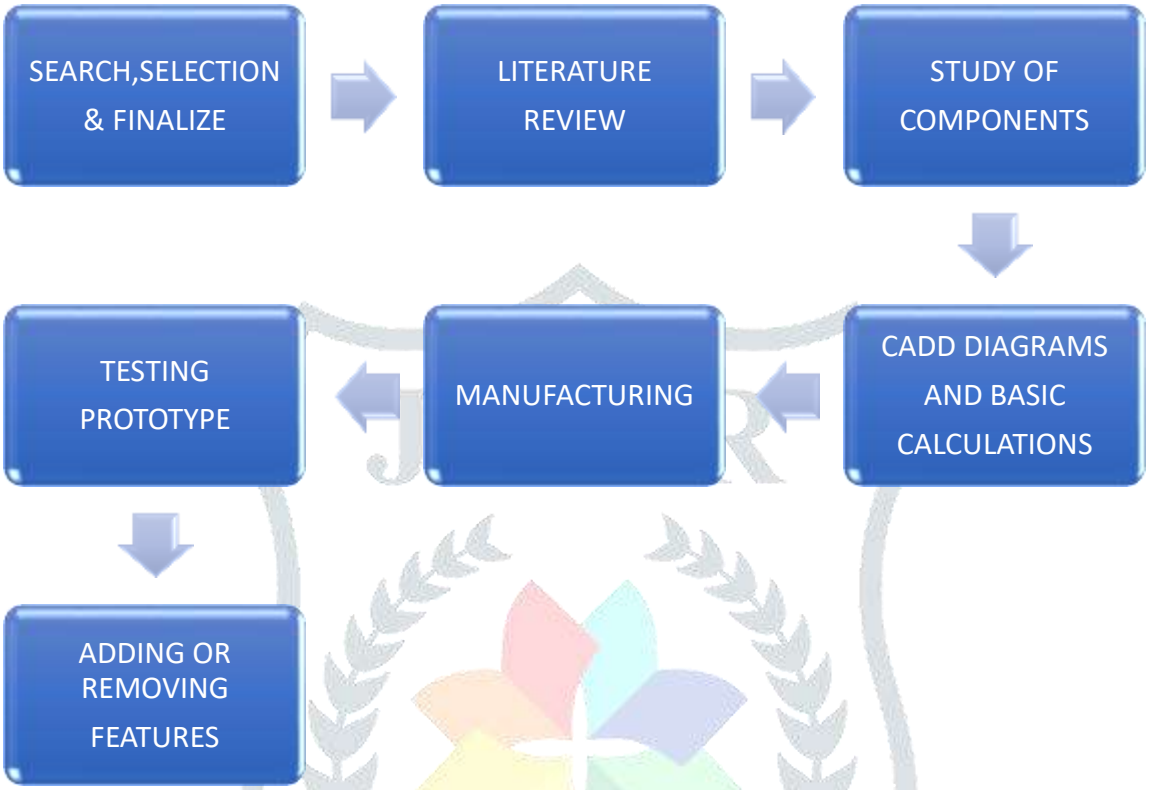
by Ajinkya S. Hande, Vivek Padole

Organic composting forms the backbone & basic necessity of a poor farmer. The traditional methods are not sufficient & satisfactory for chopping the crop residues. Whereas buying the chemical fertilizer is not possible for every farmer due to its high cost. Organic waste chopping or shredding machine accelerates the process of composting by increasing the surface area of crop residues for aerobic degradation thereby reducing the time to obtain the compost from 4 Months to 3 Months. When the crop residues come through the hopper in thecutting chamber then due to the cutting blades & hammer blades it gets chopped intodifferent sizes depending on the diameter of the sieve used thereby increasing the surface areaof residue to decompose early. A portable machine serves for various problems like moving from one place to another, requires less space & is less bulky as compared to the existing bulky machines. It also helps the farmers to start small business thereby making them self- dependent. Machine can be used for various purposes like chopping, to obtain animal fodder, bed for poultry birds, etc which makes it a multipurpose machine. Design & development of the machine done taking into consideration various literature reviews & needs of farmers. Fabrication with proper dimensions & consideration of required parameters provides for an efficient “Portable Organic Waste Chopping Machine”.

The Basic occupation of about 90% of population in India is agriculture. A variety of crops are cultivated in India. But after harvesting them the crop residues are either burnt out or thrown as waste without taking into consideration their nutritive value. With the increase in population our compulsion is not only to stabilize agricultural production but also to increase it further in sustainable manner. Excessive use over years of agro-chemicals like pesticides and fertilizers may affect the soil health and lead to declining of crop yields and quality of products. Hence, a natural balance needs to be maintained at all cost for existence of life and property. The obvious choice would be judicious

use of agro-chemicals and more and more use of naturally occurring material in farming systems. Organic farming is a system, which avoids or largely excludes the use of synthetic inputs (such as fertilizers, pesticides, hormones, feed additives etc) and to the maximum extent feasible relies upon crop rotations, crop residues, animal manures, off-farm organic waste, mineral grade rock additives and biological system of nutrient mobilization and plant protection. It helps in maintaining environment health by reducing the level of pollution. It reduces human and animal healthhazards by reducing the level of residues in the product.

V. METHODOLOGY



VI. 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*I = 12*2 = 24 Watt

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

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

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.

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/m3

Poisson's Ratio = μ = 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*Mt*L/G*θ)1/4

Mt = 41.6 Nm

G = 78000 N/mm2

ɵ = For 0.3m=1 degree

d = 17 mm

Diameter of Shaft = 18 mm standard available.

VII. 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.

7.3.1 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

7.3.2 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.

7.3.3 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.

7.3.4 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.

7.3.5 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.

VIII. RESULT

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

IX. 3D MODEL AND PROJECT DESIGN

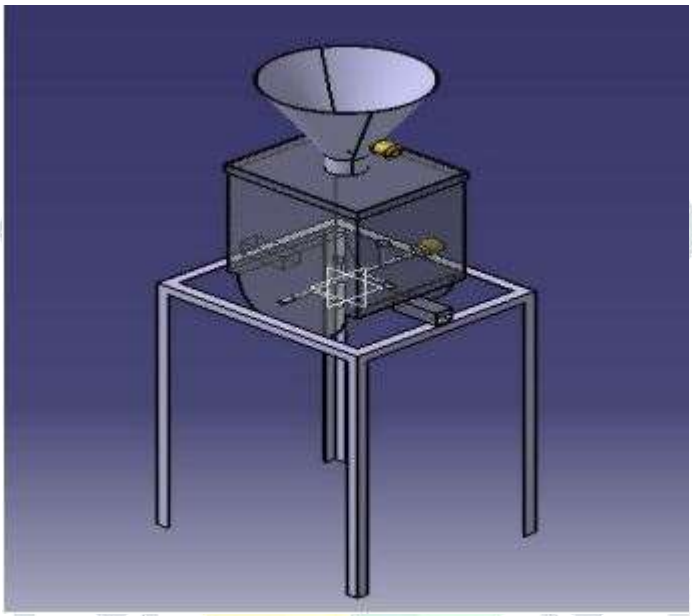


Fig9.1 Catia Design: CATIA 3-D diagram of Organic Compost Machine

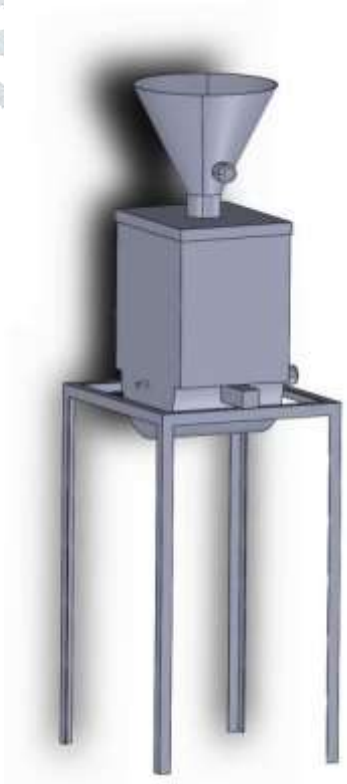


Fig9.2 Organic Compost machine (Solidworks Render)

X. COMPONENTS USED

- Hopper:

Inlet through which the waste is fed to the machine

- Shredder:

To shred the waste in fine particles so that to treat it in the mixing process.Shredder motor– 300 rpm

- Container – Mild Steel:

Rectangular container inside which the mixing process of waste begins.
Setup weight – 25 kgs

- Blade motor – 5 rpm:

Blades planted on the shaft for mixing of the waste.Blade motor – 5 rpm

- Stand:

To support the Container, Shredder Structure.

- Shaft:

Shaft diameter – 12mm. Blades are mount/welded on the shaft.

- Ceramic heater:

Heater used to apply heat to the waste inside the container.

- Temperature Sensor:

Used to show the temperature inside the container so as to further control theheating to maintain a certain temperature.

- Moisture Sensor:

Show the moisture content/levels inside the container

- Arduino Uno:

Used to control the Temperature & Moisture Sensor

XI. ARDUINO UNO CODE

```
#include <LiquidCrystal_I2C.h>
LiquidCrystal_I2C lcd(0x27, 16, 2); // I2C address 0x27, 16 column and 2 rows
int relay = 2;
// Include the libraries we need
#include <OneWire.h>
#include <DallasTemperature.h>
// Data wire is plugged into port 2 on the Arduino
#define ONE_WIRE_BUS 10
// Setup a oneWire instance to communicate with any OneWire devices (not just Maxim/Dallas temperature ICs)
OneWire oneWire(ONE_WIRE_BUS);
/*
 * The setup function. We only start the sensors here
 */
void setup() {
  pinMode( relay, OUTPUT);
  digitalWrite( relay , HIGH);
  Serial.begin(9600);
  lcd.init(); // initialize the lcd
  lcd.backlight();
  sensors.begin();
}
```

```
void loop() {
// call sensors.requestTemperatures() to issue a global temperature
  // request to all devices on the bus
Serial.print("Requesting temperatures...");
  sensors.requestTemperatures(); // Send the command to get temperatures
  Serial.println("DONE");
  // After we got the temperatures, we can print them here.
  // We use the function ByIndex, and as an example get the temperature from the first sensor only.
  float tempC = sensors.getTempCByIndex(0);
  // Check if reading was successful
  if (tempC != DEVICE_DISCONNECTED_C)
  {
    Serial.print("Temperature for the device 1 (index 0) is: ");
    Serial.println(tempC);
  }
  else
  {
    Serial.println("Error: Could not read temperature data");
  }
  lcd.clear();                // clear display
  lcd.setCursor(0, 0);        // move cursor to   (0, 0)
  lcd.print("temprature:");         // move cursor to   (0, 0)
  lcd.print(tempC);   // print message at (0, 0)
 // print message at (2, 1)
  if ( tempC > 70)
  {
    digitalWrite( relay , HIGH);
    lcd.setCursor(2, 1);        // move cursor to   (2, 1)
  lcd.print("Heater :- OFF");
  }
  else {
   digitalWrite( relay , LOW);
      lcd.setCursor(2, 1);        // move cursor to   (2, 1)
  lcd.print("Heater :- ON");
  }
}
```

XII. 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.

XIII. 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 IjagbemiChristiana.Oa , Adepo S. Olusegun 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
- 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
- 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
- Parameters Effecting Performance of Composting https://www.sciencedirect.com/topics/engineering/composting-process#:~:text=Four%20main%20factors%20control%20the,temperature%20and%20oxygen%20(aeration)

- Hande Ajinkya, Padole Vivek, "Design and fabrication portable organic waste chopping machine to obtain compost". IJIRST –International Journal for Innovative Research in Science & Technology| Volume 2 | Issue 03 | August 2015 ISSN (online): 2349-6010
- Design, Development and Evaluation of a Small Scale Kitchen Waste Composting Machine By IjagbemiChristiana.Oa , Adepo S. Olusegunb IOSR Journal of Engineering (IOSRJEN) www.iosrjen.org ISSN (e): 2250-3021, ISSN (p): 2278-8719 Vol. 04, Issue 04 (April. 2014), ||V6|| PP 29-33