

## CASE STUDY ON VARIOUS WASTE PROCESSING COMPOSTING TECHNIQUE'S PREVAILING IN INDIA

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### ABSTRACT

*Waste is becoming a great danger to our planet. Every country in the world is facing a great problem in disposing waste which is generated from different industries, livelihoods, houses, restaurants, hotels and many other types of activities. Now with lack of dumping areas governments of many countries are searching the ways to treating the waste before dumping them or dumping the waste in the landfills. Governments are making different laws to treat the waste before dumping it. Like ways India has also started with the **Swatch Bharat Mission**. The main concern of the Indian government is in treating the waste before disposing / dumping the waste and using the residue for the land filling. Many laws have been enforced by the Indian government also. Government says that before disposing the waste, the waste should be segregated in two main forms i.e. bio degradable waste (Green waste / Wet waste) and non-bio degradable waste (Dry Waste). The Green waste can be treated in two main ways i.e by Methane or Composting (Organic Manure). In this case study we have study the different types of Composition techniques prevailing in Indian market, to get the best results depending on the waste generated per day by different sources.*

**Keywords:** *Compost, Bio Degradable Waste, Composting Techniques, Composting Machines.*

### Introduction

The waste is generated/ catered from different sources like Residential, Industrial, Commercial, Institutional, Construction sites, Municipal services, Processing or manufacturing, agricultural, etc. The wastes from different sources are mainly in solid, liquid and gas forms. Solid waste comprises of Wet waste and dry waste. Wet waste is generally termed as bio degradable waste like food waste, vegetable waste, cooked or uncooked waste. Dry water contains mostly of Paper, Cardboards, hardboard used in packing, plastic packing materials, polythene bags, metal pieces, glass pieces, cloth, etc.

The bio degradable waste is treated before its disposal which will help us to reduce its size and weight. **Compost** converts the waste into a useful soil nutrient which can easily mixed with soil to make it more fertile and it also add nutrients to the soil.

Composting can be done by different methods but it depends on the quantity, type of waste, time of composting of Bio degradable waste. In this study I have taken different ways of composting by manual as well as mechanical means.

### Compost

Compost is decomposing of organic compound into simpler form by process of composting. The compost is rich in nutrients like Nitrogen, Phosphorus, Potassium, Carbon. The compost is used in farms, gardens, agriculture, organic farming, etc. Compost is a best solution till date which can be used to convert the organic decaying substances into a soil nutrient / conditioner.

Decaying of the organic compounds are done by bacteria, actinobacteria, fungi, protozoa, rotifers, earthworms.

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There are three phases of converting the bio degradable waste/ organic waste into compost under ideal conditions they are as follows:

- **Mesophilic Phases:** Decomposition is carried out in moderate temperatures.
- **Thermophilic Phase:** As the temperature rises and attends the temp from 50 degree to 60 degree the decomposition is done by various thermophilic bacteria.
- **Maturation:** In this phase the temperature starts decreasing and once again mesophiles predominates.

#### Methods of Composting

- **Vermicomposting:** Vermicomposting (Vermi-compost) is conversion of wet waste into compost using special worms, red wigglers, earthworms in specially designed underground/ overground pits. As the worms move and eat the bio degradable material and produces the casting through the digestive system.

Vermicomposting comprises of two techniques:

- Bed method
- Pit method.

We have taken the SNRE Vermicompost bed (PVC cloth foldable rectangle - open box type) of capacity 50 kg per day waste. Size of the bag 6ft length x 2ft width x 1.5ft height. The pit is opened and then installed on the site it was a easy process. The waste is to be grinded first and then mixed with 3 to 4 kg of husk or can also be mixed with cow dung (25 kg). The PVC bag is also having water drain system at the bottom of the bed. To treat every day waste separate pits are required. 60 to 90 days required to convert the organic waste into the compost. Large space is required to install these pits and due to large size pits, different pits for every day composting. Unskilled labour required to place the mixture of the bio degradable waste prepared. Moistening of the pits are to be done on periodic basis, also the rotation/ turn of the beds of the mixture with interval of 5 to 7 days.

Compost will have dark brown, moderately loose, crumbly. The worms are been separated by sieving the compost after removal it from the pits and then it is packed. The worms are placed back in the pit with new bio degradable waste mixture. Only 40% to 50% of the Waste volume will be reduced in this process with good moisture content. Bad odour shows that the fermentation is not complete. Vermicomposting is one of the cheapest methods, with no involvement of electricity. One of the drawbacks of vermicompost is that we cannot process non-veg, oily food and spicy food.



Filled and unfilled beds



Many Beds to convert the waste to Compost for the commercial use



Earthworm & Red wigglers used to convert the waste into compost

- **Vertical Stack Composting:** it is a huge bio-mechanical box made of PVC or Wooden material with bottom opening for collecting hummus/ compost and another side having a tap to drain the excess water and moisture. The feeding of the waste is done from the top before adding waste the waste is mixed with sawdust and bio culture. The mechanical box is a completely closed unit so there is no chance of unpleasant smell in the surrounding as well as it will protect the gathering of the flies and other insects around the compost unit.

The size of the Bio mechanical box is generally 5 ft x 3 ft x 3 ft. that saves the space as compared to the Vermicomposting. As the vertical stacking saves the horizontal land area. The process of making compost in the vertical box is very easy and comfortable as the mixture is to be added in the box from the top, the chimney effect of the chamber helps to converting the waste heap into compost in a faster time.

The time taken to convert the waste into compost is only 21 days. Also, no overturning is required so only a person can do the complete work. The unit is best to be use in houses as well as the residential apartment's which will help the mission of treating the waste at the source itself and using the compost in the garden or plants in the houses and gardens of the apartments.

One of the major disadvantages of the vertical stack compost is it cannot process oily and non-veg food like egg, shells, fish, chicken & mutton, bones, etc. It is best to be used for the garden or agriculture waste and also good for non-cooked food.

The reduction of the waste into the compost is 50% to 60% (volume of the waste reduced). The quality of the compost is good, light odour, moisture content 60 to 70 %, high content of nutrition, dark brown in colour, pH value range between 7.2 to 7.8, non-sticky, free from insects and nematodes, mealy. This all happen due to favourable condition inside the chamber with proper temperature and aeration, that makes the compost free from all unwanted chemicals, insects, and smell producing microorganisms.

- **OWC (Organic Waste Converter):** OWC is a semi mechanical method of composting. This method involves two basic system i.e. Mixing and Racking.

### Process

There are four steps involved in this composting system.

- **Segregation of Organic Waste:** that is make the organic waste free from non-bio degradable waste like glass, plastic, metal, paper etc.
- **Feeding the Segregated waste in the Mixer:** A Mixer/ grinder unit is basically a chamber having a metal shaft horizontally placed in it with non-sharp blades, that rotating at very low RPM, with a lid on top. The segregated waste is put in the chamber and the half proportion of saw dust is added to it and then 50 to 100 gm of bio culture is added to the chamber. As the machine is switched the shaft rotated and mixes the waste with saw dust and the bio culture.  
(note: - saw dust is added to absorb the water content of the organic waste)
- **Collecting the Raw Compost in the Tray:** the raw compost is collected in the tray placed at the bottom of the machine.  
(note: - number of trays depends on the quantity of waste)
- **Placing of the Tray in Curing Racks:** the trays are placed in a stacker which is having sprinkler system for curing/watering making moist the raw compost placed in the trays. The trays are market and move such a manner that 1<sup>st</sup> day to 10<sup>th</sup> day. The stacker is made of Angle with rows placed one over the other having max height 7ft. The composting is done in a open place. Every day the sprinkler is switched on and a particular amount of moisture is added in each tray and the manual rotation of the raw compost is done placed in the trays.
- **After 10 Days Compost is Ready:** to remove from the try and packing of the compost for sale or use in gardens.

This process of composting requires a large space, 2 to 4 labour, constant monitoring for placing of the try and switch on and off the sprinkler system – all for mixing the Raw compost already in the tray, periodic shifting of the trays. The composting of 50 kg to 500 kg organic waste can be done. The compost machine is also used to treat the municipal as well as the residential organic waste. The waste reduced is 50% only. The separate area is required and the space is kept out from the residential area as the composting area have a bad odour and it also attracts flies, rats, insects.



Machine View



Trays Placed in Curing Rack

- **Biogas:** Another one of the old and conventional system is Bio methane-fication or bio gas plants. Treating of the organic waste in bio gas plant gives two products-
  - Methane – alsoknown as Bio Gas.
  - Compost

The process of bio gas involves processing of organic waste in anaerobic condition (the fermentation of the organic waste is done in absence of the oxygen, the bacteria grow over the waste to break it in simpler form – separating CH<sub>4</sub>, H<sub>2</sub>O, H<sub>2</sub>S, CO<sub>2</sub>, CO leaving the fibre and water as the left over.)

For Bio gas digester is required, the size of the digester depends on the quantity of the organic waste to be treated per day. Gas holder is also required to collect the bio gas. The fermentation time required is 20 to 30 days. Water is also required to be added in the organic waste to enhance the fermentation and the movability of the waste inside the digester.

Example → If we have to treat the organic waste of 500 kg per day, then we require a digester of size 500+250 kg water = 750 kg per day (called as slurry). The size of the digester will be 750 ltr X 30 days = 22500 ltr. This shows the size of the digester changes with the daily waste capacity.

The working of a bio gas plant starts with crushing of the organic waste in the crushers having blades and adding 50 % water in it (50% of the weight of the organic waste) and passing the mixture in the digester for the fermentation. The digester is a closed unit which is only having a inlet pipe and outlet pipe – both the pipes are opposite to each other. After 30 days the compost comes out in liquid form – which is further passed through screw press machine which separates the excess water from the compost and makes it dry, dark brown colour. Digester can be made of bricks, concrete, PVC, Metal sheet, FRP. Bio gas holder are made of Metal sheet, PVC balloon shapes, Metal tanks.

The Bio gas produced can be used for cooking (filtered or Raw bio gas can be replaced by LPG), lighting (in generators as fuel), vehicle fuel (Compressed bio gas CBG like CNG). The study of the bio gas plant also shows that the 1<sup>st</sup> day feed will give its 100% result after 30 days and so we have to add the waste daily with the designed quantity, to get the best output and best result. Bio gas plants can be used to treat the organic waste from the small waste generator to the Bulk waste generators (i.e. 0.5 kg to tones). The main advantage of bio gas plant is it gives bio gas and compost. Also, bio gas plant reduces the organic waste to 80 to 90% (means the compost quantity is 15 to 20 %).



Metal bio gas plant with crusher, filter, booster pump



Small bio gas plant to treat 20 to 50 kg



Big bio gas plant to treat 1 ton to 500 tons of waste per day waste

- **Mechanical Heating Technology:** is a high technology composter which naturally converts organic waste to compost within 24 hours by using its special micro-organisms developed through advanced biotechnology.

This mechanism is used to convert the organic waste into compost by evaporating the excess of water present in the organic material and adding little bio culture to convert the organic material into compost. Before using the machine, the organic waste is to be sorted and made free from non- bio degradable wastes (like metal pieces, glass, cloths, etc to protect the blades of the crusher). The compost is put in the machine from the top and the compost is to be collected from the bottom.

The machine consists of:

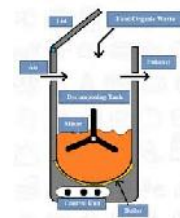
- **Crusher:** used to crush the organic waste and then transferred into the decomposing tank. The crusher rotates at speed of 100 to 200 RPM, the crusher is having the twin shaft system in which both the shaft with teets moves and brings the waste inside them.

- **Decomposing Tankwith Heater:** plays the main part where it is having heating system. The heating helps to evaporate the excess water present in the organic waste. The heating is done by ceramic heater/ Solar heating/ oil-based heating/ direct filament heating. The tank is having a horizontal shaft with vertical blades.
- **Mixer:** rotates at the speed of 10 to 20 RPM, so that waste does not spill out from the tank. The main purpose of the mixer is that at time of heating the waste should not stick to the surface of the tank and also the slow rotation of the shaft helps the waste to convert in the compost fast.
- **Drainage of Gas and Moisture:** to prevent the environment of the foul gas they are first treated by scrubbers and then leave in the environment through vertical hose pipe. The moisture comes out from the drain placed at the bottom of the machine.

The machine is capable of converting the organic waste from 25 kg to 1000 kg per day. Different models are made depending on the quantity of the waste to be treated per day. The compost is to be collected at the bottom tray or by opening the bottom opening. Compost is ready with in 24 hr. Mechanical heating machine can be used in urban areas and inside the cities, also as it requires a less space and the looking of the machine is also good. The Mechanical Heating Machine reduces the organic waste into compost to 80% to 90% (i.e. 100 kg of organic waste will generate 10 to 20 kg of the compost), the nutrition value of the compost is low as compared with others. It requires a lot of electricity to run the crusher motor, mixer and heating system.



100 kg per day organic waste composting machine  
Size of the machine depends on the waste to be treated



Inside structure of the machine

### Practice of Compost

The best way to reduce the organic waste of the municipal, residential, garden, apartments, restaurants, Hotels, mess and other institutes, industries producing the organic waste. Every government of different countries are now making laws for the bulk waste generators to treat the waste at their place and convert the organic waste into compost and to use the compost in the garden or near by areas. In this study we have study the various techniques to convert the organic waste into compost. This study will help the small/ Bulk waste generator to select or choose the appropriate method of composting depending on the space to install the composting unit, quantity of the organic waste to be treated daily, quality of the compost generated. This study also shows the composting of the organic waste will help a lot in solving the waste dumping problem of the country.

### Suggestion and Recommendations

The suggestions given by the researcher based on the present study are given below:

- The best way to overcome the problem of organic waste is to treat the waste at the source.
- The waste Generators can select the techniques depending in their requirements.
- The Government and NGO's should also help in spreading the awareness of treating the organic waste.
- The Ngo's and Government bodies to come forward and educate for the techniques of composting.
- Ngo's and Government bodies to fund or provide subsidy on the composting machines/ techniques.
- Ngo's, CSR's and Government bodies to build the Community Composting Plants.
- There should be meeting to educate the Residential and society to maintain the composting machines and the techniques.
- There should be the provision of loan by banks to the waste generators, to purchase compost machines/ techniques.

### Conclusion

This study will help waste generators and the society to select the appropriate method of composting depending on their needs. This will help the Country and the world to treat the organic waste into compost – reducing the waste and enhancing the soil fertility.

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