Garden Waste Management by Composting Process

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Abstract- Now a days in India, all cities are suffering from numerous increasing problems generated from solid waste like bad odour, nuisance in surrounding, health issues etc. are caused. To overcome these problems, there is a need to have a proper efficient and effective study of waste management system. The aim of this paper is to analyze the amount of garden waste generated within the college campus and successfully convert it into the stable and effective compost by using composting process. Composting is the acceleration of natural process of breakdown of organic material into a more stable organic substance. The composting is so prepared using aerobic composting method. Raw material as garden waste. Enhance their suitability for application to soil as fertilizing resources after having undergoing composting. This paper focuses on the aerobic composting of garden waste. In the presence of oxygen, microorganism consume organic matter and release heat and carbon dioxide, resulting into compost. This activity will be performed in the aerated drum which is called as composting tumbler. The composting of garden waste is carried out in tumbler due to its benefits such as acceleration of overall process, elimination of composting odour spreading into surrounding, keeps animals away and compost safe. It is easy to use because it can be turned easily in 360 degree manually. Composting tumbler is also tidy and attractive. The material inside can be mixed thoroughly which allows the compost to get ready quickly. The tumbler generates high quality compost. This process enables us to reuse of garden waste produce in college campus into the manure which provides essential natural nutrients to plants for their growth.
The end result will possibly be the product that is more stable and consistent, making minimum impact on the surrounding environment.

Keywords –Composting, Aerobic Method, Waste Management, Aerated Drum

I. INTRODUCTION

The aim of this paper is to utilize the garden waste generated within college campus as a manure which will helpful to create college campus as green campus. The objectives of the study are as follows:

1. To produce a product that can be used to support plant growth and can be further used as soil fertilizer.
2. To increase recycling levels and reduction of garden waste in campus.
3. To improve garden waste management in the college campus.
4. To retain the maximum nutrient contents of soil.
5. To manufacture the unit that will convert the organic waste into their byproducts.
6. To promote the treatment and reuse of garden waste.
7. To reduce health hazard.

- *Why composting?*

Solid and liquid wastes are produced by every institute, and hence there are many forms of solid wastes, which include organic wastes which further categorized into different forms which include garden waste. In most of the institute the organic garden waste management is not proper and hence they are not utilizing the garden waste as a usable form of manure for plant growth. Green wastes contain high concentrations of nitrogen. Green waste can be used to increase the efficiency of many composting operations and can be added to soil to sustain local nutrient cycling

We create a space for composting known as tumbler and the organic garden waste is directly added to the aerated tumbler. In aerobic decomposition, bacteria and fungi which thrive in high oxygen conditions are responsible for the decomposition. This form of decomposition occurs in an aerated tumbler that allows air to enter. With aerated tumbler compost can be formed in a matter of a few months, and even faster if the organic material is turned regularly.

- *What is Organic Waste?*

Organic wastes contain materials which originated from living organisms. There are many types of organic wastes and they can be found in municipal solid waste, industrial solid waste, agricultural waste, and wastewaters.

Organic wastes are often disposed of with other wastes in landfills or incinerators, but since they are biodegradable, some organic wastes are suitable for composting and land application.

Organic materials found in municipal solid waste include food, paper, wood, sewage sludge, and yard waste. Because of recent shortages in landfill capacity, the number of municipal composting sites for yard wastes is increasing across the country, as is the number of citizens who compost yard wastes in their backyards. On a more limited basis, some mixed municipal waste composting is also taking place. In these systems, attempts to remove inorganic materials are made prior to composting.

- *What is mean by Composting?*

Composting is an aerobic biological process that accelerates and controls the natural process of organic matter decomposition by controlling mixtures of organic materials and the environment in which they are transformed. The end product of this process is a beneficial and stable product called compost (Fig.1). Composting is an efficient and economical way of utilizing waste and provides plants and soil with multiple benefits. In composting, microorganisms convert organic materials such as manure, sludge, leaves, fruits, vegetables and food wastes into product like soil humus. Through composting organic waste materials are decomposed and stabilized into a product that can be used as soil conditioner or organic fertilizer. Decomposers include bacteria, actinomycetes and fungi that are widespread in nature. These are indigenous to soil, dust, fruit and vegetable matter and waste of all sorts, so special organisms are not required. Controlled decomposition occurs as a result of activities of these naturally occurring microorganisms.

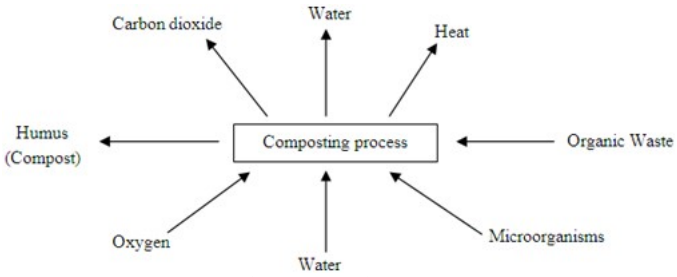

Fig.1 Composting

The four ingredients are mandatory for the composting organism to work effectively:

1. Carbon : brown material, provides for energy and the microbial oxidation of carbon produces the heat.
2. Nitrogen: such as fruits and vegetables are used to grow and reproduce more organisms to oxidize the carbon.
3. Oxygen: to oxidize the carbon for decomposition process.
4. Water : in the right amounts to maintain activity without causing anaerobic conditions.

Another important composting factor is the temperature. Unlike the common belief that states that high temperatures are essential for good compost, excessively high temperature slow down the decomposition activity of the organic matters.

II.PROPOSED METHODOLOGY

2.1 The Methodology used is depicted below:

Composting by aerobic method:

The composting method has been chosen to be aerobic one for various reasons. First, the aerobic composting is fast since the microorganisms in it consume and decompose the organic matter quickly and more efficiently than the anaerobic one. Second, anaerobic composting needs to be done underground to prevent O_2 in the compost, which makes the task more complicated. The aerobic-composting, however, works in an above ground environment and requires no digging into the soil and makes the process easy and efficient. The process chosen is rapid composting process. This method requires continue turning of the compost in order to allow the microorganisms to get enough O_2 to accelerate their activity. Moreover, continue turning prevents the compost from overheating, which kills the microorganisms and pushes the composting process to restart from the beginning.

Composting Tumbler:

The whole process of composting will be carried out by using composting tumbler. The aerobic composting with the help of composting tumbler has been chosen for following reasons.

1. User and environment-friendly: Supply of compost manure for garden plants, trees, etc. No need of outside

fertilizers. It will help to keep environment clean and green. Hence it will be an user and environment friendly.
2. Easy to operate: It will be easy to operate and protect the compost from rain. It will help to retain the temperature inside also.
3. Saves space: It will require small space compared to other method of composting.
4. Minimizes labour and supervision: It will help to minimize labour and supervision.
5. It will be an odour free hence absolutely hygienic.
6. It will prevent compost from rodents and other animals.

Fig. 2- Composting tumbler

In order to study compost, composting tumbler of 200 L capacity was used fig.3. The main unit of the composter, i.e., the drum is of 0.92 m in length and 0.54 m in diameter, made up of 5 mm thick HDPE plastic sheet. The drum is place axially (along the length) i.e. shaft (metal rod) inserted through the centre of the sides of drum which is mounted on metal stand at an height of 1m from ground. Drum is further rotate manually. In order to carry out the appropriate mixing of garden waste (grass, leaves) 10 mm diameter of bar is provided diagonally inside the drum. In addition to that 10 mm holes are provided for aeration on the surface of the drum.

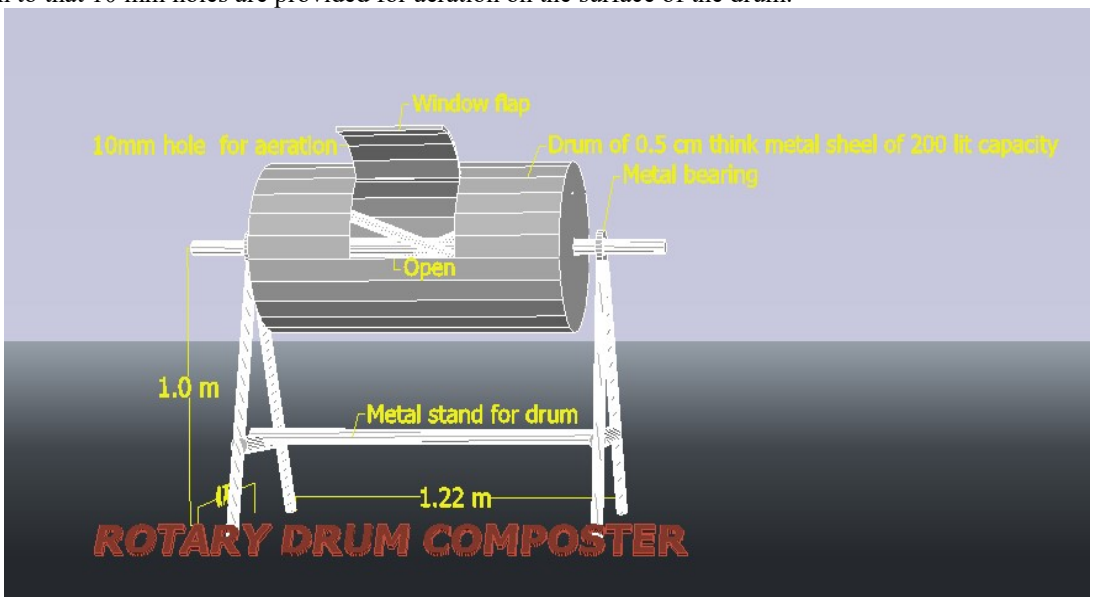

Fig. 3 -Schematic diagram of Composting Tumbler

Samples Preparation for Composting-

Fig.4 shows the shredded mixed organic waste material are loaded in three layer 1st layer is of coarse material (small branches of tree, wood chips) having depth is 3 inch. 2nd layer is of low carbon material consist of green grass having depth 2 inch and 3rd layer is of high carbon materials consisting dry leaves, newspaper etc. having depth 3 inch and lastly over all three layer soil is loaded to a depth of 1 inch (initially agricultural soil is beneficial) filled up to 70% of total volume in sequentially.

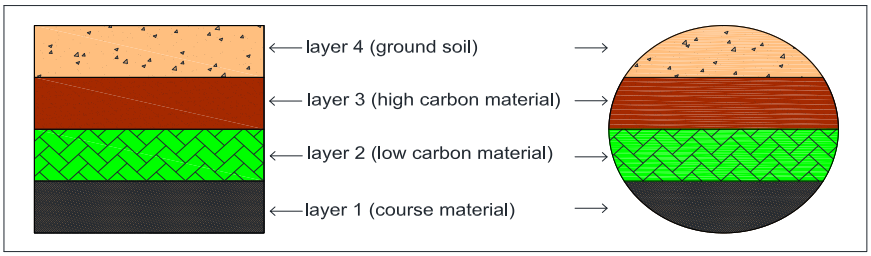

Fig.4 Alternate layer of composting

2.2. Methodology-

Detailed work is carried out during the study as per the following flow chart (fig.5) which shows the step by step procedure of the work conducted.

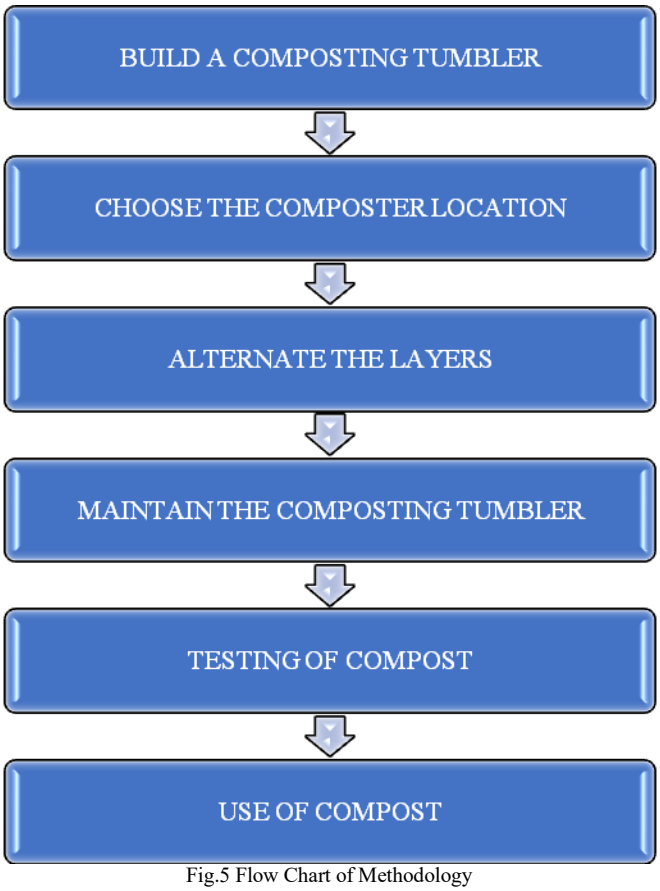

Fig.5 Flow Chart of Methodology

1) Build A Composting Tumbler

Composting tumbler of 200 L capacity was used made up of HDPE plastic sheet.

2) Choose The Composter Location

The location has to be dry, having uniform landform, and abundance of sunlight throughout the day. The composting tumbler has been set up where there is partial shade but sun can still reach the tumbler, but not so much that the heat will destroy the compost inside.

3) Alternate The Layers

After the model is installed and ready to go, the material to be compost is placed inside the tumbler. Third layer of coarse material having depth is 3 inch. Low carbon material having depth 2 inch and high carbon materials having depth 3 inch and lastly above all three layers, soil is loaded to a depth of 1 inch. This alternate layering is repeated until the 70% of tumbler is filled.

4) Maintain The Composting Tumbler

After the layers are laid inside the tumbler, the regular rotation of the tumbler is carried out. 4 rotations after 2 days of interval has been carried out. The moisture inside the tumbler has been examined regularly. If the content was too dry, watering was done. Ideally the content should be not too wet (it may give bad smell) and not too dry (may take too long to compost).

5) Testing Of Compost

When the compost was ready, various tests were conducted on the content so as to check the quality of the product obtained. Tests such as Nitrogen test, Potassium test, Phosphorous test, pH test were conducted.

6) Use Of Compost

Basically the compost was made to nurture the growth of the plants. The compost obtained can be used at home gardening and also at institution level to give plants nutrients which are helpful in health and growth of the plants.

III. Experiment and Result

Table -1 Experiment Result of first cycle

Parameter	Unit	Result	Standard Values
Ph	-	8.07	5.5 - 9
Electrical Conductivity	µs/Cm	310	350
Nitrogen	Mg/Kg	950	1100
Phosphorus	Mg/Kg	125	150
Potassium	Mg/Kg	295	300

Considerable changes in pH value occur during the composting process. In the beginning, the formation of organic acids and carbon dioxide lower the pH value to approximately 5.0 or less, where as the process progress the pH value reached to 8.0 to 8.5. The pH of compostable material influences the type of organisms involved in the composting process.

Electrical conductivity shows salinity of soil, standard value for E.C is 350 µS/cm, our result is 310 µS/cm is in safe limit. Nitrogen content standard value is 1100 mg/kg and our result value is 950 mg/kg, hence our result value is nearer to the standard value and it is beneficial for plant growth. phosphorus having standard value of 150 mg/kg and our result value 125 mg/kg which is near to standard value, potassium standard value and result values are 300 mg/kg and 295 mg/kg are nearer to each other and hence our results are in the limit, and beneficial for development of plants.

Table -2 Experiment Result Of Second Cycle

Parameter	Unit	Result	Standard Values
Ph	-	8.5	5.5 - 9
Electrical Conductivity	µs/Cm	326	350
Nitrogen	Mg/Kg	962	1100
Phosphorus	Mg/Kg	128	150
Potassium	Mg/Kg	283	300

Considerable changes in pH value occur during the composting process. In the beginning, the formation of organic acids and carbon dioxide lower the pH value to approximately 5.0 or less, whereas as the process progress the pH value reached to 8.0 to 8.5. The pH of compostable material influences the type of organisms involved in the composting process.

Electrical conductivity shows salinity of soil, standard value for E.C is 350 µS/cm , our result is 326 µS/cm is in safe limit. Nitrogen content standard value is 1100 mg/kg and our result value is 962 mg/kg , hence our result value is nearer to the standard value and it is beneficial for plant growth. Phosphorus having standard value of 150 mg/kg and our result value 128 mg/kg which is near to standard value, potassium standard value and result values are 300 mg/kg and 283 mg/kg are nearer to each other and hence our results are in the limit, and beneficial for development of plants.

Advantages of Composting

1. Reduction in quantity of garden waste.
2. Promote higher yields of agricultural crops.

3. Improves garden waste handling.
4. Reduce the risk of pollution.
5. Reduce or eliminate the need for chemical fertilizers.
6. Good quality of soil nourisher.

IV.CONCLUSION

We had successfully developed a composting tumbler that will convert the garden waste into stable, matured and nutrient enriched compost. The variations of pH was 8.07, electrical conductivity 310 µS/cm, nitrogen 950 mg/kg, phosphorous 125 mg/kg and potassium 295 mg/kg in first cycle (i.e. Winter cycle) at the end of 46 days. In second cycle (i.e Summer cycle), the pH was 8.5, electrical conductivity 326 µS/cm, nitrogen 962 mg/kg, phosphorous 128 mg/kg and potassium 283 mg/kg at the end of 40 days during the composting of garden waste using composting tumbler. In summer cycle, formation of the compost was completed earlier by 5 to 6 days as compared to winter cycle. The so obtained result of pH, electrical conductivity, nitrogen, phosphorus and potassium in both cycle are nearer to the standard values. Hence, the compost obtained after composting of garden waste using composting tumbler can be used for the plant growth and norishment and also minimizes the garden waste produced.

ACKNOWLEDGEMENT

It is indeed a great feeling of pleasure and pride to present the “Garden Waste Management By Composting Process”cases study at Jawaharlal Darda Institute Of Engineering And Technology Yavatmal.We express our profound gratitude to our guideProf. R. N. Pantawane, Assistant Professor and Head of Department, Department of Civil Engineering.We thankful to all lecturers of Civil Department and all this person who helped directly or indirectly in completing our paper successfully.

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