CONVERSION OF BIODGRADABLE WASTE INTO COMPOST

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ABSTRACT

The objective of this research work was to recycle biodegradable waste by using novel suitable composting technique. The Composting is a method by which stabilization of waste in to useful product by means it is for land filling, mass reduction of solid waste is done and hence the waste return to the natural cycle as an organic substance. Mixtures of organic materials which are components of biodegradable wastes were recycled by decomposing them under a controlled environmental condition. The initial moisture content of each of the materials make up the compost mixture and classified as wet and dry materials. It is a biological conversion, heating, which generates desired end products such as substrates for cultivation of plants and fertilizers. At the end of the process, a stabilized organic matter which can be used as fertilizer supplement by horticulturists, landscapers, orchardists, Farmers etc, was obtained. 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. 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.

Keywords: Biodegradable waste, composting, organic matter, environmental conditions.

1INTRODUCTION

Landfill and incineration have until now been the most widely used means of organic waste disposal throughout the world, the land filling of biodegradable waste is proven to contribute to environmental degradation, mainly through the production of highly polluting leachate and methane gas. Methane constitutes one of the six greenhouse gases responsible for the global warming. The efficient method to dispose the organic waste is by composting it to use in agriculture field.Composting is a method by which stabilization of waste is done for land filling, mass reduction of solid waste is done and hence in this way the waste return to the natural cycle as an organic substance. The Composting is beneficial in soil fertility enhancement, stabilizing the environment, decreasing the global warming, improving the waste

management system etc. Composting has been used as a means of recycling organic matter back into the soil to improve soil structure and fertility. Composting is the biological degradation of organic substrates aerobically or anaerobically under conditions of temperature and moisture suitable for acting micro-organisms to thrive, with a final product stable for storage and application to soil without adverse environment environmental impact. Composting of waste involves decomposition of organic waste into humus known as a fertilizer. Compost is a key ingredient in organic farming. Compost is rich in nutrients. Also organic composting converts the ammonia waste to useful nitrogen rich product. The recycling of compost to land is considered as a way of maintaining or restoring the quality of soils, mainly because of the fertilizing or improving properties of the organic matter contained in them.

2 Organic compost machine

The composting machine consists of a composting drum made from mild steel, and is enclosed by an outer cylinder mounted directly on a frame. This box houses a heating coil mounted just behind it.. Heat is produced by an electrically controlled heating coil, regulated by a thermostat, which warms up the air in the box. This heated air, by means of convention heat transfer, warms up the inner cylinder/composting drum in which the waste materials to be composted are stored in order to achieve a slow drying of the materials to be composted are stored in order to achieve a slow drying of the materials. A shaft passing through the center of the composting drum horizontally and spans through the length of the composting drum inside, attached withthe masher help in uniform mixing, which is being driven by a geared motor. Simultaneously, the mixing and the low-heat addition (drying) processes occur over a period toachieve the desired result.

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. The proper management of temperature and moisture content decreases the time period required for composting. Due to which the segregation and improper landfilling is restricted.

2.1Design of compost machine elements.

Design factors such as availability of component parts, ease of machinability, affordability, efficiency and ease of operation were considered in the design of the kitchen waste composting machine.

2.1.1Composting Drum.

The composting drum is a small sized cylindrical-shaped made of mild steel. It is the major container of the waste materials, and it houses the masher with its shaft.

The composting drum's total volume is given by:

$V = \pi r^2 l$.

Where, V= volume of the drum.

r= inner radius of the drum.

l= total length of the drum.

2.1.2Masher Assembly Design

B = Axial distance between mashers

T = Tolerance between drum and first mesh.

W = Distance of flight perpendicular to flight $BCos\emptyset + T$.

Ø = helix angle.

Masher Thickness = (length h $ofinnerdrum$ - w) / ($Noofmas hers$)

Volume of masher =1/3 ($\pi r^2 T$)

For n mashing surfaces, volume = V x n.

Mass of masher = density x volume.

$forceperunit$length = $force/total$ length.

2.1.3 Shaft Diameter

The diameter of the shaft is given by the equation:

d = 16 /π (Ss √Mb x Kb) ² x (Mt x Kt) ²

Where, Mb = maximum bending moment,

Mt = maximum torsion moment,

Kb = combine shock and fatigue applied to bending,

Kt = combine shock and fatigue applied to torsion,

Ss = allowable shear stress for shaft with keyways.

2.1.4 Maximum Volume of Waste

Maximum volume of food waste that can be composted at a time is given by:

VA = VD – VM.

Where, VA= Actual volume of inner cylindrical drum.

VD = Volume of inner cylindrical drum.

VM = Volume of mashers.

2.1.5 Heat Generated by Heater

The amount of heat generated Q, is determined using,

Q = MC (ø2– ø1).

Where, M = Mass of heating coil.

C = Specific heat capacity of air = 1.0035J/KgK = 1003.5J/gK

ø2 = Final Temperature of heating coil.

ø1 = Initial temperature of heating coil.

Mass = Density x Volume of heating coil.

Power consumed P is the heat generated per hour, which is given by:

P = QT.

Where T = Time (in seconds) = 3600sec (For 1 Hour).

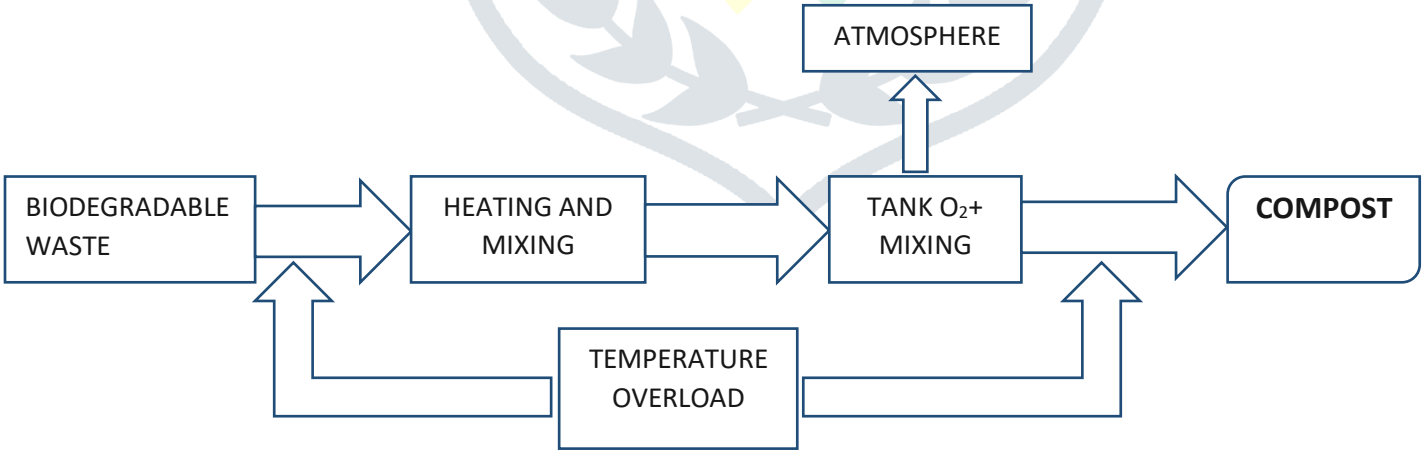
2.1.6 Design of heating chamber

Volume of heater chamber = L x B x h.

2.1.7 Machine Frame

The machine frame consists of the following parts: the, composting drum and heater box.

3 Flow chart of composting process.



4 BENEFITS OF COMPOSTING

Pathogen removal

Enrich soil

Economical

Alternative for landfilling

Practical and convenient

Healthier plant

5 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.

5.1 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.

5.2 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 waste. 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.

5.3 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. 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.

5.4 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.

5.5 Aeration rate

The aeration rate is the one of most important parameters for the composting process. The main purposes of air supply to composting is 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 distribution of gases, moisture, temperature, and the decomposition rate of the organic matter. The aeration provides oxygen to inhibit anaerobic condition and support the aerobic microbial activity. In addition, it removes the waste gaseous products. Physical turning (mechanical and non-mechanical) of the mass, natural convection, and forced aeration (positive and negative modes) are well-known ways to control effective aerobic composting. Lack of aeration can lead to anaerobic conditions and excess aeration will increase the cost the heat, as well as the loss of moisture and ammonia.

Result and discussion

Dry the biodegradable waste until the moisture content is completely dried up, this dried waste is mixed with red soil & additives to get the perfect compost mixture. This mixture is loaded into the compost drum & the motor is made to run for about 7-8 hours for uniform mixing, simultaneously the heater is switched on & the heat is supplied for about 2 hours in regular alternate intervals of time for every 15 minutes, then this mixture is left in the air tight drum for the next 16-17 hours and after a total of 24 hours the organic compost is ready to use for its applications.

SAMPLES	pH	NITROGEN (kg/ha)	ORGANIC CARBON (%)	PHOSPHOURS (kg/ha)	POTASSIUM (kg/ha)
1	6.89	4025.99	4.70	1777.81	1702.4
2	6.90	4045.44	4.99	2156.55	1881.6
3	7.21	3763.2	6.17	2665.30	2284.3
4	7.12	3743.75	5.58	1664.75	1971.2

Samples used:vegetable waste, dry leaves, paper, sheep manure, cow manure, red soil.

Conclusion

Composting is an environmentally friendly method of treating waste which convert organic waste into useful product. Compost has a lot of benefits like: reduce landfill space, reduce surface and groundwater contamination, reduce methane emissions, reduce transportation costs , reduce air pollution from burning waste, provide more flexible overall waste management, enhance recycling of materials and can be carried out with little capital and operating costs. The organic compost machine helps to improve composting and decreases the cost required for degradation, segregation, and transportation etc. of the waste. The flexibility is increased and the total volume of organic waste is minimized. Also the quality of the compost is depends upon factors such as moisture content, pH, temperature, time etc.

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