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A STUDY ON AEROBIC COMPOSTING OF KITCHEN WASTE, ORANGE PEELS, COFFEE GROUND USING BIN COMPOSTERS

[1]D V Vara Manasa [2]Tripura Sahithi Illa

[1]Assistant Professor, [2] Project Assistant
[1]Department of Civil Engineering
Dr. Lankapalli Bullayya College of Engineering, Visakhapatnam-530013,
Andhra Pradesh, India

***Abstract*- The present study is demonstration of preparation or blending of the waste, usage of different materials and construction of an easy and economical composter, using the final compost for plants. Home composting is considered as a best waste management technique such that it reduces the transportation and collection costs and reduces the burden for landfills besides giving the best output called compost. Since the composting bins available in the market are pricey, to conduct the study, bin composters are prepared similar to those available in the market by using plastic bins and drilling holes circumferentially and on the cover. The blending of carbon and nitrogen sources is worked out numerically and also the moisture content. The initially parameters of the compost were determined theoretically, such as pH, electrical conductivity, density, moisture content, total nitrogen, total phosphorus, total potassium, total organic matter, CN ratio**

***Keywords:* Composting, Kitchen Waste, Coffee Grounds, Orange Peels, Aerobic Composting**

I. INTRODUCTION

The solid wastes generated in India are disposed in landfills. So, that there is a burden for the landfills and cause major problems such as leachate generation and methane emission. The overall methane emissions from the landfills were 0.334Tg/year said by NEERI (National environmental engineering research institute) in 1990-1991. High population growth, decreasing rural prospects and shifting from low-paid rural areas to highly paying urban areas, contribute in large part to the development of urbanization. Urbanization contributes directly to waste generation and non-scientific waste management creates health risks. Solid waste management is considered as one of the major challenges in the world due to their rising population, urbanization, and industrialization. Proper waste management involve segregation of waste, proper collection of waste and as well as storage. In many countries the food waste that is generated is half the MSW generated. In developing countries this may be greater than 50%. Organic wastes such as fruits, cooked food waste, vegetables, meat etc. Kitchen waste was one of the organic wastes generated in the kitchens. Kitchen wastes have high moisture content, so leachate generation is a big problem. But kitchen waste has a high number of biodegradable compounds so that can be composted and use the end product obtained from it. Composting is considered as a self-heating process that converts organic material into humus like substances. During composting the waste material undergoes various changes, determining the changes are necessary to get good quality of compost. For the application of the compost on agriculture it is necessary that the compost obtained should have stability and maturity. The maturity is nothing but the degree to which the waste material was degraded. Composting is one of the most well-known biological stabilization procedures for organic solid wastes, transforming them into a safer and more stable (compost) material that can be used in agricultural applications as a food source and soil conditioner. Improper management of waste causes generation of toxic and infectious material. Other high-risk group includes population living close to a waste dump and those, whose water supply can be contaminated either due to waste dumping or leakage from landfill sites. There are various methods which can be used for proper disposal of waste which could not harm the environment and human life as well. Some of them are incineration, composting, sanitary land filling etc. Food and kitchen waste contribute about 30% of household waste, which is organic in nature and is easily degradable. Composting is one way to degrade this type of organic waste into stable products. Home composting can be considered as best waste management technique for the organic waste generated at homes. The quantification of the waste that is generated from the home composting is necessary because by knowing the quantification we can determine the amount of organic waste that is reduced at the source itself. For the better waste management, the treatment of the organic fraction which is mostly generated from the houses is necessary because 50-60% of the municipal solid waste contains organic fraction. Techniques are available for the treatment and reuse of the organic materials that are aerobic degradation and anaerobic digestion. The compost that is obtained

from the aerobic degradation can be used as natural fertilizers whereas in the anaerobic digestion, biogas is produced and that can be used to produce the energy and fuel. The home composting technique can be done at the source itself by giving less environmental hazards. This treatment is best for the small volume wastes and those too organic wastes. The degradation in this process was done by the aerobic microorganisms and gives out the compost. Hence home composting techniques gives the best solution for these developing countries and increasing population.

II. Materials Used

In the present study vegetable and fruit peels and coffee ground, orange peels are used. Vegetable and fruit peel waste generated from the kitchen are collected. Also, moisture content in vegetables and fruit waste generally is more than 60% thus, moisture content of the feed material was maintained by itself during the initial phases. The waste used in the study mainly contain vegetables that are not rotten but cannot be cooked either and peels of vegetables and fruits. The finished compost is then compared with the commercial compost bought from a local nursery.

III. EXPERIMENTS

3.1 pH

The composting process is relatively insensitive to pH within the range commonly found in mixture of organic materials, largely because of the broad spectrum of microorganisms involved. The preferred pH is in the range of 6.5-8.5. pH does become a consideration with raw materials containing a high percentage of nitrogen. A high pH above 8.5, encourages the conversion of nitrogen compounds to Ammonia.

3.2 Moisture Content

Moisture is the lifeblood of the metabolic processes of the microbes. Water provides the medium for chemical reactions, transport nutrients and allows the microorganisms to move from place to place. Efficient activity is achieved when the moisture is maintained between 40%-60%. At moisture levels above 60%, water displaces much of the air in the pore spaces of the composting materials. Moisture levels should be maintained so the materials are thoroughly wet but not waterlogged or dripping excessive water.

3.3 Odor and Color

Odors are the single biggest threat to a composting operation. Aerobic composting does not generate odorous compounds as the anaerobic process does. Objectionable odors can come from certain raw materials or the process itself if composting is not properly managed. Compost color should vary between middle and dark brown. Darkness also depends on the moisture content.

3.4 Electrical Conductivity

Electrical conductivity is a fundamental property of a material that measures how strongly it resists electric current. A low resistivity indicates a material that readily allows electric current. The parameter is expressed in the ohmmeter. Electrical conductivity is the reciprocal of electrical resistivity. It represents a material's ability to conduct electric current, the electrical conductivity is expressed in siemens per meter

3.5 Density

Density, mass of unit volume of material substance. The formula for density is $\rho = M\ V$, where M is the mass of the mass, and V is the volume. Density is commonly expressed in units of grams per cubic centimeter.

3.6 Particle Size

Different end uses of composts have different particle size requirements. The particle size of the compost is important as the specific size is to maintain correct porosity and water-holding capacity. Particle size is less critical when applied to farmland, although large particles can affect the spread ability of the compost. Best composting conditions are usually attained when the material's particle size ranges from 1 to 2 inches in diameter.

3.7 C/N ratio

C/N ratio is one of the most important parameters to determine the extent of composting and degree of maturity. It is a useful guide to formulate the composting recipes, but the rate at which carbon compounds decompose must also be considered. Raw materials blended to provide a C/N ratio of 25:1 to 30:1 is ideal for active composting, all the initial ratios of 20:1 up to 40:1 consistently give good results. Mixes with C/N ratios higher than 40:1 require longer composting time for the microorganisms to use the excess carbon because of the available nitrogen.

3.8 Microorganisms

The role of microorganisms in the compost process cannot be underestimated. They can either be present non-deliberately or inoculated. Microorganisms degenerate large biomolecules of wastes into forms of nutrients that can be used to promote plant growth.

3.9 Nitrogen

Nitrogen is one of the most important elements for plant growth when there is a deficiency of it, plant growth and development is impaired. Nitrogen is a significant constituent of chlorophyll and responsible for the green color in plants. Compost has been reported to contain optimum N content required for plant growth. High accumulation of nitrogen in compost fertilizer is not a common occurrence because due to mineralization, nutrients in compost fertilizer is released gradually. Excess Nitrogen in plants because of fertilizer over-application can result in rapid growth, brilliant green color, and a diminished root system. In extreme cases, excess nitrogen can cause the burning of the leaf tissue and the plant's death. Deficiency in nitrogen causes a loss in the green color of leaves, stunted growth, low protein content, and yellow coloration.

3.10 Phosphorus

Phosphorus is a constituent of the complex nucleic acid structure of plants, which regulates protein synthesis. Phosphorus is, therefore, important in plant's cell division generation of new tissue and complex energy transformations in the plant. Adding phosphorus to soil low in phosphorus promotes root growth, winter hardiness, stimulates tilling, and often hastens maturity in plants. Deficiency in phosphorous can lead to stunted growth, poor seed and fruit development, delayed maturity, and there could be a change in the color of the matured leaves to characteristic dark blue to blue–green coloration in plants. Compost has been reported to contain optimum phosphorus concentration necessary for plant growth.

3.11 Potassium

Potassium is an element necessary for proper plant growth. It increases plant growth, carotene, and chlorophyll contents. It promotes the vigor and color of plants. Potassium is needed for the plant to create sugars. It is also essential because it helps the plant to resist disease and survive adverse weather conditions such as drought and cold. The deficiency of potassium in plants can lead to scorching and browning of tips of older leaves, which progresses to the total leaves with time. Weak stalks could also be associated with potassium deficiency. According to Kammoun, et al., composts are good sources of substantial phosphorus required for plant growth.

IV. EXPERIMENTAL SETUP

The experimental set up for aerobic compost requires an enclosed structure that keeps the composting material together and helps to retain heat and moisture. Plastic bins having top diameter of 240mm and bottom diameter as 180mm and height 280mm, the bins are drilled holes circumferentially to provide proper aeration such that leachate will not be generated, and anaerobic conditions will not be occurred.

V. EXPERIMENTAL PROCEDURE

Vegetable and fruit wastes in bin 1, coffee ground in bin 2 and orange peels in bin 3 are added into different bins as the nitrogen source. Microorganisms use the nitrogen source as energy source for their growth. Which in turn breaks down the material and turn it into manure. Dry leaves are then added into the bins as carbon sources. The carbon sources provide texture to the compost. Sour curd is sprayed upon the leaves as inoculant. And once the bin is full it is closed with a lid to cover the compost and to avoid rodents. The entire content of the bin is turned every 3rd day for the initial 10 days and twice until the next 10 days.

Table 5.1 Comparison of variation in Parameters for different Samples

Parameters	Commercial Compost	Kitchen Waste 1	Kitchen Waste 2	Orange peels	Coffee Grounds
pH	6.9	8.28	8.6	8.2	8.4
Electrical Conductivity	0.175	0.163	0.122	0.203	0.163
Moisture Content	4.44	6	7.14	4.17	3.3
Density	0.31	0.37	0.4	0.6	0.43
Total Organic Carbon	9.68	2.436	4.9	22.52	2.07
Total Organic Matter	16.68	4.199	8.447	38.83	3.568
Total Phosphorous	0.101	0.019	0.134	0.778	0.021
Total Potassium	0.039	0.029	0.031	0.063	0.026
Total Nitrogen	0.323	0.256	0.434	0.522	0.251
C:N Ratio	17.3:1	9.5:1	11.2:1	43.1:1	8.2:1

Fig 5.1 Kitchen Waste Vs Different Parameters

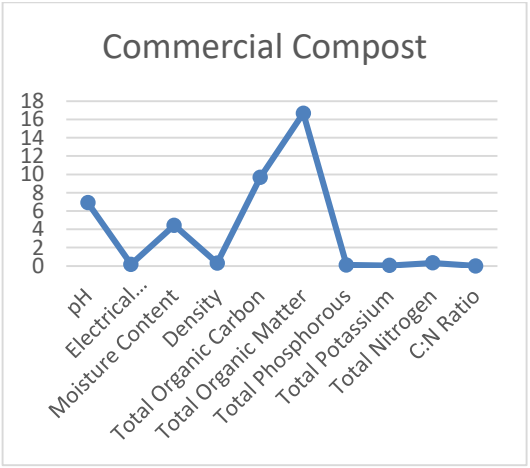

Fig 5.2 Commercial Compost Vs Different Parameters

Fig 5.3 Kitchen Waste 2 Vs Different Parameters

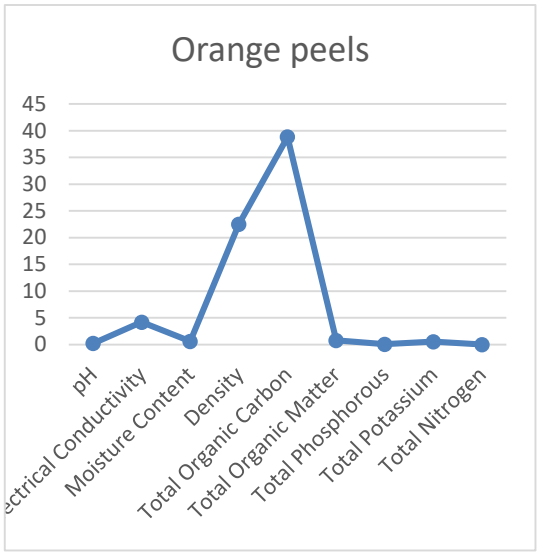

Fig 5.4 Orange Peels Vs Different Parameters

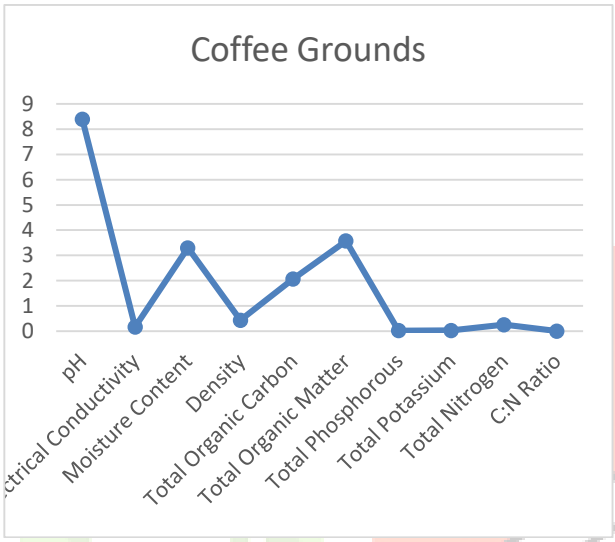

Fig 5.5 Coffee Grounds Vs Different Parameters

VI. CONCLUSION

Composting of organic waste has become a principal method of waste reduction, disposal, and reuse because it produces a final product that is stable, free of pathogens and plant seeds, and can be beneficially applied to land. Composting can also reduce the emission of greenhouse gas emissions. The purpose of the study is to encourage the home composting process The bin composter that are available in the market are pricey, hence an easy and economical design of bin composter is adopted. Taking plastic bins of desired size and drilling holes circumferentially and on the bottom and top. According to the analysis, pH of the compost is slightly high, the electrical conductivity id really low which indicates the absence the salts and is fine. Moisture content is low that reflects there was a need for extra moisture and that had to be supplied, the reason could be air drying of the sample. However, there was no odor and leachate generated, and the compost was ready in 45 days. The compost is finely graded. The chemical composition is acceptable. The compost prepared can be used as a soil improver, growing media but cannot be called as a fertilizer. Based on the current study, the conclusion can be drawn that bin composting system can be adapted for safe and hygienic disposal of organic waste. Moreover, bin composting is convenient and environmentally safe

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