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Study of Composting for Municipal Organic Waste A Review

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***Abstract*— Escalating population erratic urbanization and vigorously changing income leads to the modified lifestyle of people in developing countries like India . That massively affects the solid waste generation which includes the organic and inorganic waste of different types that are dumped directly to the outskirts of the city or in landfill sites that simultaneously challenging the ecological balance by producing greenhouse gases. Over the last few years, the immanent campaign SWACHH BHARAT MISSION commenced by the government helps to strengthen solid waste management (SWM) and new technologies. Composting is one of the prominent methods to decompose organic waste to make waste to wealth in an economic way. This study gives an overview of the composting method which is affected by various parameter such as aeration rate , appropriate temperature(40-70 °C), moisture content (50-60%), pH(5.5-8) , carbon and nitrogen ratio(C/N). This paper is aimed to review the composting method and its byproduct compost as the best suitable soil conditioner.**

Keywords—Composting,organic waste(OW),solid waste management

1. INTRODUCTION

The population of the world has increased rapidly, it has expanded from 3.1 billion to 9.3 billion from the year 1960 to 2010. The researchers believe that it will increase to 9.3 billion by the year 2050 (FAO, 2013). This burgeoning growth in population leads to the socio-economic development of people that give rise to solid waste generation at an alarming rate, which is 2.01 ton/year in 2016 which is expected to reach 3.40 billion ton/year by 2050(World Bank, 2018).and by the year 2025 one third contributor to the world solid waste is produced by Asia (Modak et.al 2010).and the poor SWM deteriorating the health of people and the environmental condition that yields degradation of natural resources which simultaneously affects the life of the citizen**.**

In the Indian scenario, the municipal waste management in megacities causing enormous environmental problems due to the absence of regulation in municipal solid waste management (MSWM) approaches (Sharholy et al, 2008) and according to (Kumar et.al 2017) more than 90% of MSW generated thrown in a wretched way in landfill or open areas .without proper segregation of degradable and inert waste that give rise to wastage of the most expensive resource the land. And unfortunately, no cities in India claiming 100% segregation at source, nearly 70% of waste is segregated then leftover 30% is frequently mixed into the urban environment, and from the overall waste collected only 12.45% waste has scientifically treated the rest dumped openly (CPCB report,2013)dumped waste in landfill also a threat to lives because it contributes about 30% of the global anthropogenic emission of the methane to the atmosphere(COM,1996) .due to all these vital issues India need an urgent waste disposal method that must be organized in an efficient manner for the management of MSW which can protect personal health and environmental resources(Kumar et al 2017).

The MSW in India has 51% of organic waste,17.5% recyclable waste(plastic, paper ,metal and glass) and 31% inert .The data explains that the major fraction of waste is organic waste(OW). For the proper management of OW, various methods are suggested, and composting is the prominent one. There are different types of composting methods vermicomposting, windrow composting, and aerobic (Indore) composting, anaerobic (Bangalore) composting suggested by the (SWMG, 2015). Composting is the best suitable way in a centralized and decentralized manner it depends upon various factors like temperature, climatic condition, moisture content, and nature of waste .the byproduct compost is a porous ecofriendly soil conditioner with bargain rates. This review will develop a new approach to the composting method.

2. COMPOSTING PROCESS

This is a feasible method to decompose the organic fraction of municipal solid waste in an economic way .composting reduces the large fraction of organic waste in less time. This process works to accelerates up the biological decay of organic waste by providing the favorable conditions for the microbes and different organisms to feed. The end product of this concentrated decomposition natural process is bio fertilizer that is compost that can help gardens plants, crops and trees to grow rapidly. According to Bertoldi et al., 1982 the organic waste should not be applied directly to the soil because plants cannot take nutrients directly from waste and this process converts the waste biomass to soil conditioner to provide nutrients to plant.

There are two type of composting i.e. anaerobic and aerobic composting. In anaerobic composting the reduction of waste mass is done by anaerobic microorganism .The major product of this composting is CH4 and H2S (Kayhanian and Tchobanoglous, 1993). In aerobic composting aerobic microorganism helps to decomposes organic waste and converts them into CO2, NO2, and NO3 (CPHEEO, 2016). Aerobic composting consumes less time than anaerobic composting for completion of composting process**.** The process of composting completes in different phases. According to Kaiser(1983) there are two phases i.e. Decomposition phase in which the three mandatory processes

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mesophillic, thermophillic and cooling in which complete degradation(breaking) of simple and complex matters occurs and Humification phase in which organic matter is converted into stable molecule form this can also be said as maturation phase of compost a fully saturated soil conditioner is formed in this phase.

3. COMPOSTING TECHNIQUES

Vermicomposting:
Decomposition of heterogeneous organic waste by earth worms in moist, warm, and aerobic environment. This is also known as worm composting because the breakdown of organic material is done by red earthworm. The byproduct compost which is granular in form is enriched in various soil nutrient (SBMG, 2015).this is also a feasible method of composting (shah et al., 2012).the vermicomposting gives water-soluble nutrients which accelerates the property of soil that can be used in gardening and small scale sustainable agricultural purposes. In India main vermicomposting plant are situated in Bangalore, Hyderabad, Mumbai and Faridabad (joshi and ahmad 2016). According to Neher et al., 2013 this method takes 60-90 days. The major advantages of vermicomposting is it produces less greenhouse gases, odor as well as there is no problem of water pollution in the form of infiltration of leachate (Khan and Ishaq, 2011). The operational and maintenance cost is also low compared to other methods.

Windrow Composting:
Windrow composting generally introduce an outdoor type of composting technique to handle a large mass of organic matter and biodegradable waste such as crop residue, animal manure that is placed in a long narrow pile(windrow) in a trapezoidal and triangular shape that are turned periodically for providing optimum moisture and oxygen to the compost pile (CPHEEO,2016).There are two types of windrow composting i.e. forced aerated windrow composting in which air is introduced externally by mechanical blowers and the other is conventional windrow composting in which the composting pile has not covered the aeration takes place naturally and turning is provided when needed. This method is best suited for the treatment of a large volume of waste. The efficiency of the method is based on the size of the pile the small size pile not able to resist typical weather condition whereas the large pile not able to aerate so there is a standard size for an ideal process that is 2-5 meter base width and 1-3 meter high(kunhlman.,1990)

Indore Composting:
In 1931 Wad and Howard invented a systematized procedure for composting in Indore, Madhya Pradesh (Fitzpatrick, 2005). This is an aerobic method which can turn organic waste such as garden waste, wood ashes, animal dung, and bagasse, sawdust, and night soil into good quality compost in less time compared to the anaerobic method In this process of night soil and vegetable, waste is piled in alternative layers in the depth of 7.5-10 cm each, the overall depth of 1.5 meters above the ground is maintained .this method takes 4 -5 months (Mishra et al., 2003) and during this time the aeration is provided by turning the pile. The NPK concentration is 0.8%N, 1.0-1.5%K, 0.3-0.5%P.

Bangalore Composting:
In 1939 Acharya had come up with a composting technology for night soil and town litter that is the Bangalore method of composting (SBMG, 2015). This is an anaerobic method and also known as the hot composting method. Urine, plant leaves, garbage, animal manure are used as raw feed. Earthen trench of about (10m×1.5m×1.5m) is filled in layers of waste and then covered with a 15cm soil layer. Within week waste started to decompose because anaerobic microorganism starts their work after 4-5 months fine brown color stabilized matter compost is ready for use. (SBMG, 2015).

NADEP Composting:
Narayan Deotao Pandharipande of Maharashtra had invented the NADEP method of composting (Edwards and Arya, 2011**).** the material used for composting can be kitchen waste, cow dung, garden waste, agricultural residue, forest litter, etc. this is an aerobic type of composting in which the composting pit developed is in a rectangular shape of 3m length and 1.8meter wide and 3.5m length and 1.5 m wide internally. The wall is 25cm thick with perforation for air. The ratio of feed is 45:5:50 for kitchen or agricultural waste, cow dung, and soil. Material is fed in layers consists of 5% cow dung with water, 50% soil, and 45% organic waste. This method takes about 3months for complete composting (SBMG, 2015)**.** According to katre et al., 2012 the NPK value of vegetable waste and three types of leaves feed is 0.84%N, 0.59%P, and 0.551%K.

In vessel Composting:
In vessel composting refers to the composting process occurring in a closed system that can be plastic or metal container or anything else. This is a controlled methodology for composting. In this method various important factors such as temperature, moisture and different factors controlled for ideal compost. This is less time consuming when operated properly. Sometimes due to anaerobic condition foul odor comes that can be reduced by proper aeration. This method is generally used for municipal scale waste processing.

4. FACTORS AFFECTING COMPOSTING

Moisture content: The moisture content of an ideal compost should be 50-60%. Low moisture content affects the activity of microorganisms as a result that the process slows down and high moisture leads to anaerobic conditions which ultimately cause foul odor and decrease the degradation of matter.

Particle size: Decreasing the size of the material will increase the surface area that simultaneously increases the microorganism activity and accelerates the composting process. While too small material reduces the flow of oxygen and air which decreases the microorganism activity so the material size should be carefully reduced for air ventilation.

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Carbon to nitrogen ratio (C/N ratio): This is the most important parameter for compost this decides the quantity of green and brown waste to be added. There should be a good balance between nitrogen and carbon for standard compost. The ratio should be 30:1 as per the solid waste manual (CPHEEO, 2016).

pH: The high or low pH value both impact reflexively on the compost. The pH value denotes the loss of nitrogen content, pH between 6-7.5 is good for bacterial growth while pH between 5.5-8 is fit for fungi growth, and when pH is greater than 7 the nitrogen volatilize in the form of ammonia.

Aeration: The aeration is necessary to avoid the anaerobic condition because the aerobic method needs air and oxygen as a main factor for providing favorable condition to microorganism for fast process. Optimum aeration fastens the process of composting.

Organism: Fungi, bacteria, and another biological organism actively involved in the composting process and their relative proportion is completely dependent upon the source feed, temperature, and oxygen supply, etc.

5. CONCLUSION

This review gives thorough knowledge about the composting process that is a growing method of waste management technology. This is a sustainable method for waste minimization and sustainable farming. Several researchers are coming with different innovative techniques for composting each year because of its increasing demand. Compost is a better option for soil amendment than chemical fertilizer because it improves the quality of soil (Ghorbani et al. 2008). It reduces the mass and volume of waste and destroys the pathogenic microorganism thus Composting is a prominent method for converting waste to wealth in an economic manner.

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