

Study of Vermicomposting Technology for Organic Waste Management

Vandana Patyal

Senior Asst Professor, Department of Civil Engineering, New Horizon College of Engineering,
Bengaluru (Karnataka), India

ABSTRACT: Urban conglomerations, with their ever-increasing population and consumerist lifestyle generate voluminous solid wastes. A substantial portion of solid waste is non-toxic and organic in nature. Existing methods to its treatment and disposal are rather expensive. Vermicomposting technology is one of the best options available for the treatment of organics-rich solid wastes [1]. The term vermicomposting is coined from the Latin word 'Vermis' meaning to the 'worms' [2]. Vermicomposting refers to composting or natural conversion of biodegradable garbage into high quality manure with the help of earthworms [3]. The driving forces behind the introduction of vermiculture and other reuse processes, is the global recognition of the need to recover organic material and return this to the natural cycle. Legislations are being enacted to prevent the dumping of organic material into landfills. Simultaneously, as the cost structures for dumping are increasing, people are becoming more aware of the need to change their practices. There is pressure for waste processing and the consumption of the end products [4]. In the present study an effort has been made to check the efficacy of *Eisenia Fetida* (red worm) in vermicomposting [5] [6]. Moisture content in bed is maintained by spreading water over it and to cover with moist gunny bag. The temperature was monitored at every week. The parameter such as pH, electrical conductivity, temperature, bulk density, C/N Ratio, N, P and K are measure during the specifics interval of time in which result show that the nutrient content at the end of 45 day is increased. Vermicompost is the process which will convert organic waste into valuable fertilizer.

KEYWORDS: Earthworm, *Eisenia Fetida*, Organic waste, Vermicomposting.

I. INTRODUCTION

Organic waste forms the major component of municipal solid waste in most Indian urban areas. If properly treated and utilised it has the potential of being an important resource for food production. Use of urban organic wastes can also reduce the burden upon municipalities of waste disposal, as well as ameliorating the environmental problems associated with untreated organic wastes [7].

In the past, urban and peri-urban farmers in India accessed relatively uncontaminated urban organic solid wastes, which was mostly 'mined' from garbage dumps, but the increasing contamination, together with other factors in urban development and management, have led to a Vermicomposting is considered superior to other types of compost because of its quality. [8]

II. MATERIAL AND METHOD

The material and the method used are as follows:

1. Collection of material: The material required for vermicomposting such as food waste was collected from hostel mess. Since the waste was almost of same size it didn't require shredding. If the waste is from different sources and of varying size then it requires shredding.
2. Collection of earthworm species: Earthworms are collected from Karnataka Compost Development Corporation, the variety used is *Eisenia Fetida* (red worm). For one-meter length, one-meter breadth and 0.5-

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 1, January 2017

meter height, 1 kg of worm (1000 Nos.) is required. It is not necessary that earthworm should be put inside the waste. Earthworm will move inside on its own[9].

3. Pre-composting: The food organics waste are spread in layer and expose to sunlight for 5 to 10 days to remove pathogenic microorganisms and noxious gases. The pre composting process takes 5 to 10 days for their completion except cotton waste which require 20 to 25 days for their decomposition.
4. Experimental-design or Vermicomposting: The Vermicomposting can be done in wooden boxes, plastic buckets or in any containers with a drain hole at the bottom. Three plastic crates of size 3"x1"x1" were selected for the process. Drain holes were made in all the crates bottom. All of them were covered with layer of newspaper at the bottom first, then a layer of pre-compost. Followed by a layer of earthworm culture and again covered with pre-compost as shown in fig. 1. Finally they were covered with moist gunny bags. The mixed waste is placed into the tub / container up to brim. The moisture level should be maintained at 60%.



Fig. 1. Container with drain holes at bottom and introducing red worms in organic waste

5. Chemical analysis: Sample were drawn weekly from the bed and analysed for pH, electrical conductivity temperature, bulk density, organic carbon, total nitrogen and total phosphorous.[10],[11]

III. BENEFITS OF VERMICOMPOSTING SYSTEM

Following are the benefits of vermicomposting system: [12] ,[13] • No odour • Cost effective Pollution free Valuable end product

1. Destruction of pathogens
2. Low greenhouse emissions
3. Established on site - no cartage
4. Scalable to suit any volume
5. Environmentally Sustainable process
6. It increases the water holding capacity of soil. This reduces irrigation up to 30%.
7. It does not have any adverse effect on soil, plant and environment.
8. Vermicomposting is an eco-friendly natural fertilizer prepared from biodegradable organic wastes and is free from chemical inputs.
9. Improves soil quality by adding nutrients.

IV. RESULT AND DISCUSSION

1. pH: Near neutral pH of vermicomposting may be attributed by the secretion of NH_4^+ ions that reduce the pool of H^+ ions. Neutral pH helpful for effective decomposition and Due to mixing of inoculants increases their pH value. The initial pH value of organic waste is 5.6 while after 28 days.value of pH becomes 7.0,The acceptable range of pH for the microorganisms is 6.0-7.5.The variation in pH with respect time days is as shown in fig. 2 below:

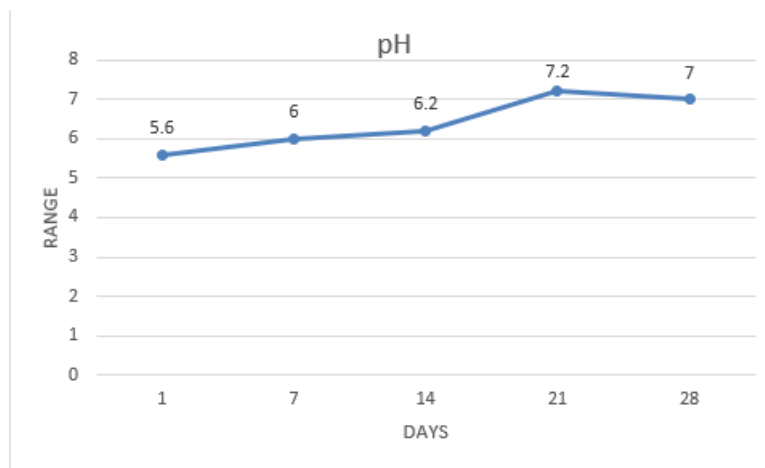


Fig. 2.Variation in pH with respect to Time days

2. Bulk Density: Bulk density is determined weekly as per the standard procedure. The variation in bulk density with respect to time days is as shown in fig. 3 below:

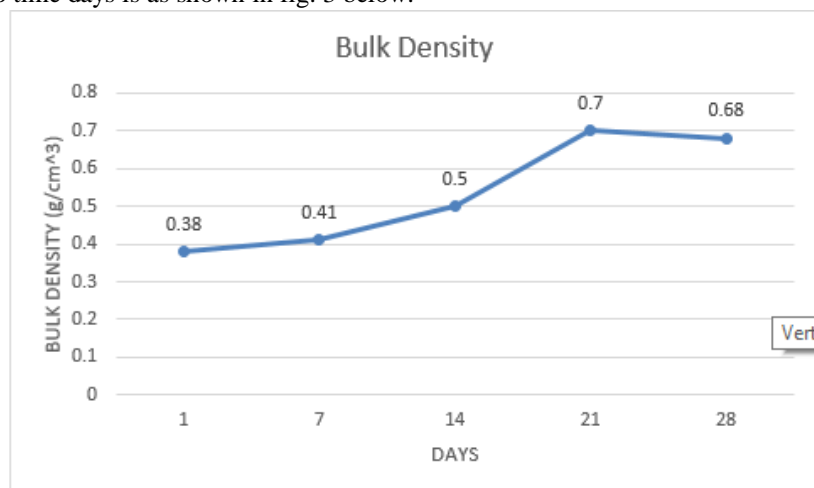


Fig. 3.Variation in pH with respect to Time days

3. Electrical conductivity: The electrical conductivity of all the bed was considerably decreasing during the vermicomposting process. The reduction of EC in all beds shows the reduction of salinity (mineral salt) considerably. The lower level of salinity is the essential character of good bio compost which is better for crop

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 1, January 2017

growth. The low value Electrical conductivity shows the greater the decomposition rate. A decrease in the electrical conductivity values in vermicomposting may be due to the presence of exchangeable Ca, Mg, and K. The initial EC value of all pits is 3.75. While after 20 days, value of B1, B2, B3 and B4, is 3.64, 3.12, 3.49 and 3.62, respectively. Whereas, value of B1, B2, B3 and B4, after 45 days is 3.51, 2.97, 3.24, and 3.47. The variation of EC is as shown below in table No.11. The variation in EC with respect time days is as shown in fig. 4.

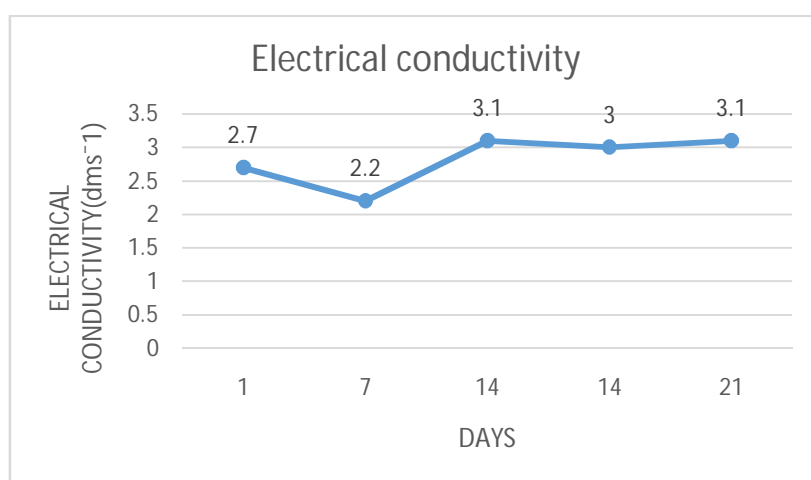


Fig. 4.Variation in electrical conductivity with respect to Time days

4. Temperature: To optimize the microbial-mediated release of plant nutrients from organic amendments such as vermicomposting, the temperature of the growing environment must be controlled. Warmer temperatures will increase both the nutrient release and growth rate of earthworm.

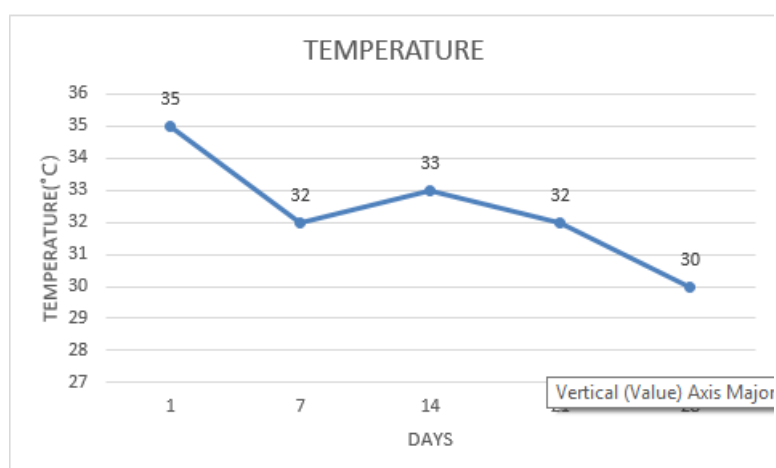


Fig. 5.Variation in Temperature with respect to Time days

5. Organic Carbon: In general, Organic Carbon loss has been observed during the vermicomposting process. Earthworm modifies substrate conditions, which consequently affects carbon losses from the substrates through

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 1, January 2017

microbial respiration in the form of CO₂ and even through mineralization of organic matter. The final value of OC after 26 days is 19.0.

6. Total Nitrogen: The Total Nitrogen present in the vermicompost is depending upon the nitrogen content of waste used. The Total Nitrogen is increasing about 12% to 16% due to the recycling of Nitrogen in the process. The involvement of nitrogen also depends on number of earthworm and types of earthworm used in compost. The inoculation of worms in waste material considerably enhances the amount of N due to earthworm mediated nitrogen mineralization of wastes. It also suggested that the earthworm enhances the nitrogen levels of the substrate by adding its excretory products, mucus, body fluid, enzymes and even through the decaying tissues of dead worms in vermicomposting sub-system. The TN value of the compost after 26 days is 1.81.
7. Total Phosphorous: The passage of organic residue through the gut of earthworm, results in phosphorous converted to forms, which are available to plants. The release of phosphorous in available form is performed partly by earthworm gut phosphates, and further release of P might be attributed to the P-solubilizing microorganisms present in worm casts. The earthworm responsible for increase in phosphorous in soils. The increase in Total Phosphorus content reveals that the vermicomposting process is in order. The phosphorus content after 26 days is 0.8.
8. Total Potassium: The amount of potassium increases gradually in vermicomposting which also depend on the amount of raw organic waste used. The increasing of content of total Potassium shows that the composting is taking place in well order. The Total Potassium value after 26 days is 0.69.
9. C:N Ratio: The C/N ratio gradually decreases. The carbon content present in the organics was utilized as source of energy for earthworms. And simultaneously, the Nitrogen is being recycled in the compost. During this process, the casting of earthworms in turn enriches the macronutrients such as N, P, and K and hence bio compost will become as an organic fertilizer. The C/N ratio is 10.5 after 26 days.

V. CONCLUSION

Composting is an effective way to manage organic wastes. It promotes environmental sustainability by converting a waste to a value-added product that improves our environment. Vermicomposting is recommended for treating and converting the huge amount of MSW generated in the city. This process will reduce the environmental damage.

Following are some conclusions of the present study:-

1. In the present work, *Eisenia Fetida*, most common species of earthworms are used and the study shows that the good quality of Organic compost was obtained
2. In the present study, the key parameters like Carbon, Nitrogen, Protein content and pH showed increase which are helpful in in improving soil quality
3. The process of obtaining bio-compost is totally natural
4. Vermicomposting technology is economical in construction and maintenance ,therefore a very good option for organic solid waste management system
5. It promotes environmental sustainability by converting a waste to a value-added product that improves our environment.

Vermicomposting is compatible with sound environmental principles that value conservation of resources and sustainable practices. In developing countries could prove to be useful in many instances. It offer good potential to turn waste material into a valuable soil amendment.

REFERENCES

- [1] Department of Environmental affairs, Republic of South Africa "Draft Guideline Document for composting" Feb 2013.
- [2] Manuel J. Fernandez-Gomez , Esperanza Romero, Rogelio Nogales "Feasibility of vermicomposting for vegetable greenhouse waste recycling" Bioresource Technology 101 ,9654–9660,2010.
- [3] V.K. Garg, "Vermicomposting technology for solid waste management", Dept. Environmental Science and Engineering, pages 1-15.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 1, January 2017

- [4] 3. Pirsahab M, Khosravi T and Sharafil K, "Domestic scale vermi-composting for solid waste management", International journal of recycling of organic waste in agriculture", pp. 1. 4. Datar M T and More A B (2007), "Vermicomposting- A technological option for solid waste management", pp. 3,2013.
- [5] Municipal Solid Wastes (Management and Handling) Rules, 2000.
- [6] Edwards, C.A.: The use of earthworms in the breakdown and management of organic wastes. Pp. 327-354. In: Earthworm ecology. C. A. Edwards (Ed.) CRC press, Boca Roton, FL, 1998.
- [7] Bhide A D and Sunderesan B.B, Processing method for future solid waste management in developing countries. Indian National Science Documentation Centre, New Delhi. Pp.124-134 .1983.
- [8] Londhe P B and Bhosle S M, "Recycling of Solid Wastes in to Organic fertilizers using low cost treatment: Vermi-composting", International Journal of Innovations in engineering research and technology, ISSN: 2394-3696, Volume 2, Issue 6, pp. 9, 2015.
- [9] Samaranyake J W K and Wijekoon S, "Effects of selected earthworms on soil fertility, plant growth and vermicomposting", Tropical Agricultural Research & Extension 13(2), pp.1,(2010).
- [10] Walkey, J.A. and Black, I.A., "Estimation of organic carbon by the chromic acid titration method", Soil Science, 37, pp-29-38, 1934.
- [11] Singh, R., Pradhan, K., "Determination of nitrogen and protein by Kjeldahl method", In: Forage Evaluation Science. Pvt. Publishers Ltd., New Delhi, p. 23-25,1981.
- [12] Taiwo, A.M., "Composting as a Sustainable Waste Management Technique in Developing Countries", J. Environ. Sci. Technol., 4(2), p.93-102,2011.
- [13] UNEP, International Source Book on Environmentally Sound Technology for Municipal Solid Waste Management", United Nations Environmental Programme, United Nations, ISBN: 9280715038,1996.