International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 10 | Oct 2019 www.irjet.net p-ISSN: 2395-0072

THE COMPARATIVE STUDY OF ON-SITE BIO-COMPOSTING AND NATURAL COMPOSTING OF ORGANIC SOLID WASTE IN HIGHER EDUCATION INSTITUTION

R.Rajapriya[1], M.Logeshwaree[2], A.Rama Prabha[3], A.Sophia[4]

[1]*Assistant Professor, Department of Civil Engineering, Velammal College of Engineering and Technology, Madurai, Tamil Nadu, India*

[2,3,4] *U.G. Student, Department of Civil Engineering, Velammal College of Engineering and Technology, Madurai, Tamil Nadu, India*

Abstract - *Onsite Bio composting increases the productivity of natural compost. It can be obtained easily and no difficult processes are involved. Nowadays fertilizers that are being used for all crop varieties are artificial and some are hazardous. To overcome this situation onsite bio- composting can be adopted in residencies and institutes. This paper discusses the best method and process to get healthy compost in 50 days. Two areas namely "AREA A" and "AREA B" are done with two different processes of composting. "AREA A" is subjected with cow dung which acts as catalyst and EM solution whereas "AREA B" is left for natural composting. The norms, regulations and procedures provided by the Indian Agricultural Research Institute (IARI) have been followed throughout carrying the tests on compost. The values of pH, temperature are checked periodically before and after adding EM solution. After 50 days tests on the composts samples are done to check heavy metals concentration. At the end the best method to be adopted to get good compost in 50 days is discussed.*

***Key Words*: Onsite bio-composting, fertilizers, compost, EM solution, heavy metals**

1. INTRODUCTION

Onsite composting is suitable for converting yard trimmings and food scraps into compost that can be applied on site. The five main areas that must be "controlled" during composting include Feedstock and Nutrient Balance, Particle Size, Moisture Content, Oxygen Flow and Temperature. Composting, or controlled decomposition, requires a proper balance of "green" organic materials and "brown" organic materials. "Green" organic material includes grass clippings, food scraps, and manure, which contain large amounts of nitrogen. "Brown" organic materials include dry leaves, wood chips, and branches, which contain large amounts of carbon but little nitrogen. Obtaining the right nutrient mix requires experimentation and patience. It is part of the art and science of composting. Mesophilic phase is the first stage of the composting process. These mesophilic bacteria can include E. coli and other bacteria from the human intestinal tract, but these soon become increasingly inhibited by the temperature. This is followed by thermophilic stage which can continue up to about 70°C (158°F), 30 although such high temperatures are neither common nor desirable in backyard compost. After the thermophilic heating period, the humanure will appear to have been digested, but the coarser organic material will not. This is when the third stage of composting, the cooling phase takes place. During this phase, the microorganisms that were chased away by the thermophiles migrate back into the compost and get back to work digesting the more resistant organic materials. The final stage of the composting process is called the curing, aging, or maturing stage, and it is a long and important one.

1.1 Effective Microorganisms (EM)

E.M. is an abbreviation for Effective Microorganisms. Microorganisms are tiny units of life that are too small to be seen with the naked eye and they exist everywhere in nature**.** EM will make a non-toxic chemical free insect repellent. It can be used to prevent pest and disease problems in the garden. It is a combined culture of aerobic microorganisms (requiring oxygen to survive) and anaerobic (requires no oxygen to survive) that co-exist together to the mutual advantage of both (symbiosis). E.M combines with the existing microorganisms within the soil. They work together to build a healthy living soil. The effectiveness of EM can be extended in soils by three applications at 8 - 10 day intervals during the first 3 to 4 weeks after planting a crop. This will insure that EM populations remain high throughout a critical a period when young seedlings and plants are vulnerable to environmental stresses (drought, heat, weeds, and pathogens). It is at this stage when the greatest loss in crop yield and quality occurs. It can increase crop yields and improve crop quality as well as accelerating the breakdown of organic matter from crop residues.

1.2 Literature review

Composting is a popular method for recycling organic solid wastes including agricultural and forestry residues. However, traditional composting method is time consuming, generates foul smells, and produces an immature product. Composting is an aerobic, microorganism-mediated, solid-state fermentation process by which different organic materials are transformed into more stable compounds. The product obtained is the compost, which contributes to the improvement of physical, chemical and microbiological properties of the soil. However, the compost usage in

agriculture is constrained because of its long time action and reduced supply of nutrients to the crops. To enhance the content of nutrients assimilable by the plants in the compost, its supplementation with nutrients and inoculation with microorganisms have been proposed. Home composting helps individuals and families to reduce the amount of household waste at the same time gaining a fertilizer material (compost) of excellent quality for gardens or vegetable plots. The volatile organic compounds (VOCs) and ammonia are some of the compounds present in gaseous emissions from waste treatment facilities that contribute to odour pollution. In the present work, the effect of the residence time on the biological stability of organic waste composted in dynamic windrows and the characteristics of compost were studied at a full-scale composting plant, aiming to provide characteristics of compost obtained from two different composting techniques depending on the composting time.

2. Materials and methods

On site composting involves the following methodology to be adopted. Proper site should be selected with a slope of 1%-6% to minimize odor related problems and ensure integrity of groundwater systems. Site clearance is succeeded by the addition of fresh chlorine free water to maintain the moisture content of ground. Concrete hollow blocks of size 40cm X 20cm X 15cm are used to create the necessary boundary and to ensure that oxygen passes through the compost for aerobic reactions to take place. The raw materials for onsite composting are collected as Green Waste and Brown waste for a period of six days from 3 different zones of the institution. These are divided and spread in the form of a heap on which fresh water is sprayed once in 3 days in both the areas to maintain temperature and moisture content. The compost is tested to determine the temperature, pH and heavy metals. The test results are compared with the standard values provided by the IARI (Indian Agricultural Research Institute), Delhi, India.

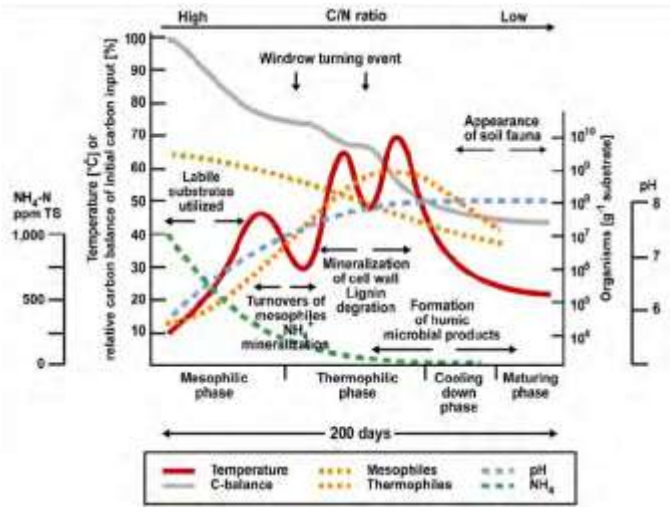

Chart -1: Stages of Composting

2.1 Quantity Estimation

The collected yard waste and vegetable scraps are dumped in the empty leveled ground and the quantity is estimated by using the weigh balance. Table 1 represents the total weight calculation of the yard waste and vegetable wastes collected in 6 days.

Table-1: Total weight of Organic waste

Days	Yard waste (kg)	Vegetable Scraps (kg)
Day 1	20.7	6
Day 2	21	32.4
Day 3	27.2	12.4
Day 4	25.8	16.2
Day 5	30.9	9.5
Day 6	19.8	34.3
Total	145.4	110.8

2.2 Determination of Temperature and Power of Hydrogen

Equipments involved in the determination of Temperature and pH are Compost Thermometer, pH meter, Beaker and Ion electrode. Table 2 represents the values of temperature recorded during different days of composting using compost thermometer.

Table-2: Temperature Recordings

Days	Area A	Area B
Day 7	36°C	36°C
EM solution is added on Day 7 and Periodically being added after 7 days		
Day 14	38°C	36°C
Day 21	40°C	37°C
Day 28	42°C	38°C
Day 35	45°C	39°C
Day 42	47°C	41°C
Day 49	48°C	43°C

From the above recordings it is inferred that micro organisms are larger in area A where the EM solution is sprayed. Table 3 represents the values of pH in different days of composting.

Table-3: pH Values

Days	Area A	Area B
Day 7	6.3	5.8
EM solution is added on Day 7 and Periodically being added after 7 days		
Day 14	7.2	6.4
Day 21	7.5	6.4
Day 28	7.6	6.6
Day 35	7.9	6.7
Day 42	8.1	6.8
Day 49	8.2	6.5
Average	7.5	6.5

From the above recordings it is inferred that pH is basic in area A where the EM solution is applied whereas it is acidic in area B where the natural composting takes place.

2.3 Determination of Zinc and Lead

Chemicals required for determining Zinc and Lead are Ethylene Diamine Tetra Acetic acid, Xylenol Orange, Buffer Solution, Hexamine and Erichrome Black-T. Table 4 represents the concentration of zinc and lead in matured compost from AREA A and AREA B in 50th day.

Table-4: Heavy metals concentration

S.No.	Heavy Metal	Area A	Area B
1.	Zinc	898.97 mg/kg	1242.2 mg/kg
2.	Lead	155.4 mg/kg	383.32 mg/kg

The presence of zinc in "AREA B" is greater than "AREA A".As per IARI, the quantity of zinc in good compost should not exceed 1000 mg/kg. From the above mentioned it is clear that "AREA A" is suitable.

The presence of lead in "AREA A" is lesser than "AREA B".As per IARI, the quantity of lead in a good compost should be within 150 to 300 mg/kg. From the above calculations it is clear that "AREA A" is suitable.

2.4 Results and Discussion

Table 5 represents the summary of results of all tests and observations.

Table-5: Summary of Test Results

Tested Parameters	Area A	Area B	Adoptable range as per IARI
Temperature°C	48°C	43°C	47°C -52°C
pH	7.5	6.5	7-9
Zinc(mg/kg)	898.97	1242.2	Less than 1000
Lead(mg/kg)	155.4	383.32	150 to 300

As per Indian Agricultural Research Institute the temperature for compost should be within 47°C -52°C. The pH value should be within 7-9. The value of zinc should range less than 1000mg/kg. The value of lead should range between 150 to 300mg/kg. From the above mentioned results it is confirmed that AREA A is suitable and the compost obtained from AREA A can be utilized compared to AREA B (from 50 days of composting).

3. CONCLUSIONS

Onsite Composting of yard waste and vegetable waste in Higher Education institution by two different methods has been implemented and tested successfully. According to this research work, addition of microorganisms to organic waste provides good compost in 50 days of maturing period compared to natural composting.

On-site composting is a significant environmental and social obligation and hence requires a proper maintenance and observation. On –site composting are done to incorporate a standard protocol for effective management of organic waste disposal.

REFERENCES

[1] Daniel González and Joan Colon "The effect of the composting time on the gaseous emissions and the compost stability in a full-scale sewage sludge composting plant", vol-654, pp-311-323, 2018.

[2] Fan Yang and Yun Li "Performance of mature compost to control gaseous emissions in kitchen waste composting", vol-657, pp-262-269, 2018.

[3] Central Pollution Control Board (CPCB) norms.

[4] Indian Agricultural Research Institute (IARI), Delhi

[5] M.AVázquez and M.Soto "The efficiency of home composting programmes and compost quality", 2017.

[6] M.Waqas and A.S. Nizami "Optimization of food waste compost with the use of biochar", vol-9, pp-1-12, 2017.

[7] Municipal Solid Waste Management and Handling rules of India.

[8] National Environmental Engineering Research Institute (NEERI), India.

[9] Òscar J. Sanchez and Sandra Montoya "Compost supplementation with nutrients and microorganisms in composting processes"– Journal of Waste Management, 2017.

[10] K.R.Atalia and D.M. Buha "Composting of Municipal Solid Waste", Volume -9, pp-20-29- Journal of Composting of Municipal Solid Waste, 2015.

BIOGRAPHIES

R.RAJAPRIYA M.E.,
Assistant Professor,
Department of Civil Engineering,
Velammal College of Engineering and Technology, Madurai, Tamil Nadu.

M.LOGESHWAREE graduated in Civil Engineering from Velammal College of Engineering and Technology in the year 2019.

A.RAMA PRABHA graduated in Civil Engineering from Velammal College of Engineering and Technology in the year 2019.

A.SOPHIA graduated in Civil Engineering from Velammal College of Engineering and Technology in the year 2019.