Retraction

Retraction: Microbial Composting (IOP Conf. Ser.: Mater. Sci. Eng. 1145 012019)

Published 23 February 2022

This article (and all articles in the proceedings volume relating to the same conference) has been retracted by IOP Publishing following an extensive investigation in line with the COPE guidelines. This investigation has uncovered evidence of systematic manipulation of the publication process and considerable citation manipulation.

IOP Publishing respectfully requests that readers consider all work within this volume potentially unreliable, as the volume has not been through a credible peer review process.

IOP Publishing regrets that our usual quality checks did not identify these issues before publication, and have since put additional measures in place to try to prevent these issues from reoccurring. IOP Publishing wishes to credit anonymous whistleblowers and the Problematic Paper Screener [1] for bringing some of the above issues to our attention, prompting us to investigate further.

[1] Cabanac G, Labbé C and Magazinov A 2021 arXiv:2107.06751v1

Retraction published: 23 February 2022
Microbial Composting

G Anusha¹, K Maruthi venkatesh², M Aravind³, S Ramakrishnan⁴
¹Professor, Department of Civil Engineering, KPR Institute of Engineering and Technology, Coimbatore, Tamil Nadu, India
²Assistant Professor, Department of Civil Engineering, KPR Institute of Engineering and Technology, Coimbatore, Tamil Nadu, India
³Assistant manager, kingfisher beverages, Bangalore
⁴Associate professor, Sri Krishna College of Engineering and Technology.
hod_civil@kpriet.ac.in, maruthivenkatesh.k@kpriet.ac.in

Abstract. Human population generates enormous amount of solid and liquid waste directly and produces industrial effluent indirectly. Due to usage of synthetic fertilizers and pesticides in the agriculture fields, man inflicts deep wounds on environment. Pollution is defined as undesirable changes occur in water, land and air. Waste generation has been observed to increase annually in proportion to the rise in population and urbanization. As more land is needed for the ultimate disposal of these solid wastes, issues related to disposal have become highly challenging.

1. Introduction
Solid waste management has become a major environmental issue in India. Generation of solid waste depends on many factors like culture and nature of the people, socio-economic conditions, commercial importance and industrial base [1]. It is observed that the total MSW generated by 299 class-I cities is 48,134 TPD (tones per day). Out of this, 62.4% of solid waste is generated by 23 metropolitan cities The per capita MSW generated daily in India is about 100 g in small towns and 500 g in big towns. The present annual solid waste generated in the Indian cities has increased from 6 MT in 1947 to 48 MT in 1997 and is expected to increase to 300 MT/year (C PCB 2000b). Disposal of solid waste is a major problem in the urban areas of the country [2]. About 20-40% of the waste generated remains uncollected on the Streets and neighborhoods. Wastes are often dumped on open land areas and dumping of wastes causes unsanitary conditions, obnoxious odors and serves as a breeding ground for many diseases. No doubt these wastes also affect public health, overall and local environment [3].

2. Technological Approach
Even though lot of “waste to energy” technological options like pyrolysis/gasification, sanitary land fill, incineration is available. Composting technology provides a greater advantage by on site reduction of the organic household waste [4].

3. Composting with Effective Microbial Solution
Composting involves the breakdown or organic waste in the presence of microorganisms, heat and moisture [5]. Three types of microorganism are involved in the process of composting—bacteria, fungi and actinomycetes—that act upon the waste to convert it into sugars, starch and organic acids. These, in compost heap help to promote the stabilized compost [6]. Specially, effective microbial solution for the treatment of waste is one of the most important technologies today.

- Recycling of waste by the generation of useful manure, which is organic in nature.
- Reduction in volume of waste to be disposed of on land.
- No requirement of any high-and technical expertise.
- Improve the nutrient value of the compost.
- Controls the odor
- Prevent the mosquitoes and flies breeding
- Most important feature is to prevent the entry of pathogens.

4. Preparation of Effective Microorganisms

The EMS contains different strains of bacterial and fungal species. The Bacterial species are: Lactobacillus plantarum, L. casei, Rhodopseudomonas palustris (photosynthetic bacteria), Cellulomonas fimii

The fungal species are: Saccharomyces cerevisiae, Candida utilis (yeasts), Streptomyces albus (actinomycetes), Aspergillus oryzae and Mucor hiemalis (fermenting fungi).

These microorganisms are isolated from soil and grown in specific media. From the specific media the microbes were taken and cultured in media which has common nutrients for all microbes. The cultured microbial solution was used for treatment [7-10]. The reason for choosing this EMS:

- Non-pathogenic
- Wide range of pH and temperature tolerance
- Co-existing nature
- Facultative anaerobic
- Rapid decomposing ability

After the preparation of mother culture, important nutrients should be provided for the growth of the microorganisms. The nutrients should be provided by jaggery. We use jaggery instead of the processed sugar because the processed sugar contains many chemicals which inhibit the growth of microorganisms.

The nutrient contents (jaggery) are added to the water and it is well stirred to dissolve. About 800g of jaggery is mixed with 50litres of water. The prepared mother culture is mixed with the nutrient and jaggery solution. The mixture is poured into a 20litre can, which should be tightly sealed to prevent the entry of air. The mixture is maintained at anaerobic condition of about seven days [11]. Figure 1 shows the effective microbial solution.

![Figure 1. Effective microbial Solution](image-url)
The nature of application culture

- PH - 5-6.5
- Colour - Straw yellow to Dark brown
- Odour - Slightly souring (due to fermentation)
- Density - 1 (As such water)

Collection of waste

One week gents hostel mess waste of an educational institution has been collected and it is separated as degradable and non-degradable. For each method of treatment 100 kg of degradable waste is used i.e., aerobic decomposition, anaerobic decomposition and conventional treatment.

For aerobic decomposition, the wastes are spread in the selected land i.e., an open area, to allow the circulation of air. For anaerobic decomposition, the wastes are dumped in the pit and it is covered with jute bags so that there is no circulation of air. For conventional treatment, the wastes are dumped in an open pit [12]. Figures 2, 3 and 4 shows the aerobic process, anaerobic process and conventional method of waste disposal.

Effective microbial solution (EMS) is sprayed into aerobic and anaerobic process to examine the
decomposition rate of municipal solid waste in comparison with conventional method (EMS is not added).

In the present study, one liter of mother culture can decompose up to 5 tons of Municipality Solid Waste.
The moisture content of at least 40% must be maintained in the solid waste for the development of
microorganisms. Therefore, water is sprayed in the solid waste for the growth of microorganisms at
regular intervals of time.
The aerobic microorganisms need both the moisture content and the circulation of air for their growth.
- The anaerobic microorganisms need only the moisture content for their growth.
- The decomposition of wastes was inspected weekly and the changes are noted.

5. Comparative Study on Rate of Decomposition of Various Methods
- After forty-five days, the volume of the waste in the aerobic, anaerobic and conventional
  methods was reduced.
- Most of the materials are decomposed in the anaerobic method when compared with the
  conventional and aerobic method.
- In anaerobic method, the waste in the lower layer is decomposed more than the waste at the upper
  layer.
- In conventional method, it is found that the wastes are decomposed at slower rate and many
  waste materials remain the same without been decomposed.

6. Analysis of Decomposed Waste
After 45 days of decomposition of solid waste, the decomposed waste was collected from the
conventional, aerobic, anaerobic method. These wastes were sieved through 4 mm size sieve. Figure 5
and Figure 6 shows the sample collected after 45 days and sieved sample.

![Figure 5. Sample collected after 45 days](image)

![Figure 6. Sieved sample](image)

7. Test on Sieved Sample
The sieved sample is tested for the following compounds:
- pH
- electrical conductivity
- nitrogen
- potassium
Tests are conducted based on standard test procedure.

8. Test Results
Table 1, shows the Comparative study of conventional, anaerobic and aerobic decomposition.

| S.No | Parameters       | Normal | Anaerobic | Aerobic |
|------|------------------|--------|-----------|---------|
| 1    | pH               | 7.49   | 7.12      | 7.34    |
| 2    | EC(dsm⁻¹)        | 2.34   | 4.36      | 4.12    |
| 3    | Organic carbon%  | 9.36   | 13.25     | 11.27   |
| 4    | Nitrogen%        | 0.73   | 1.23      | 1.06    |
| 5    | Phosphorus%      | 0.42   | 0.61      | 0.57    |
| 6    | Potassium%       | 0.47   | 0.78      | 0.52    |

Apart the quality of the compost, the aerobic decomposition method decomposition rate also high. The volume reductions were more compare with anaerobic decomposition and conventional method. Figures 7-12 shows the comparison of pH value, Electrical conductivity, Organic carbon, potassium, Nitrogen and Phosphorous.
Figure 8. Comparison of Electrical conductivity

Figure 9. Comparison of Organic carbon

Figure 10. Comparison of potassium

Figure 11. Comparison of Nitrogen
9. Discussion
The results clearly indicate the quality of the compost. The aerobic decomposition contains high amount of nitrogen and phosphorus compared with conventional decomposition as well as anaerobic decomposition. The nitrogen value of aerobic decomposition was 14.45% and the total phosphorous value of aerobic decomposition was 27.02% more than the anaerobic decomposition. But in the anaerobic decomposition, potassium value was 0.46 which was more than 11% when compared with the aerobic decomposition. In the overall quality of the compost, the aerobic decomposition was so good when compared with the other two decomposition methods.

EMS application on Municipal Solid Waste in the present study offers high hope in converting them into effective manure for farming. In comparison with conventional and anaerobic decomposition method, the EMS treated aerobic decomposition method has more organic carbon, Nitrogen and Phosphorous. It is suggested that the Municipal Solid Waste can be used as manure after ruling out the existence of pathogenic microbes, since Municipality Solid Waste have been blamed for the transmission of Salmonella spp and other human diseases.

However, it is reported that the colonization of lactic acid bacteria controls the population of pathogenic microorganisms such as Salmonella spp., Enterococci and E. Coli. The EMS in the present investigation has two strains of lactic acid bacteria (Lactobacillus platarum and Lactobacillus casei) which the investigation believes could control the pathogenic microbes.

10. Conclusion
The present study was envisaged to treat the municipality solid waste by using eco-friendly cost-effective method with the help of Effective Microbial Solution (consortium of Microorganism). An effort was also made to municipality solid waste converting to effective and natural manure through Effective Microbial solution.

- The Effective Microbial solution contains nine different species of microorganism, which are nonpathogenic, eco-friendly, facultative and co existing nature.
- Three methods of Municipality Solid Waste have been taken for the experiment.
- The first method was called conventional decomposition method; it was not gone for any treatment.
- The second method was called aerobic decomposition. It was treated with Effective Microbial Solution (EMS) in the first, and then air circulation and the optimal moisture content is maintained
for compost.

- The third method was called anaerobic decomposition; it was treated with Effective Microbial Solution (EMS) in the first and then only the moisture content is maintained.
- After 45 days, samples have been taken from each method and sent to analysis.
- From the analysis result, the aerobic decomposition was so good when compared with conventional and anaerobic method.
- Some literature said, the lactic acid bacterium controls the pathogen from the waste. Fortunately, EMS contains two strains of lactic acid bacteria which is helpful to controls the pathogens.
- In this case, microorganism plays a vital role in improving the available nutrient contents of nitrogen, phosphorus and potassium considerably.
- Anaerobic treatment with EMS shows good result than aerobic treatment and conventional method.
- Anaerobic treatment with EMS possesses less work because mixing of the waste is not necessary since it does not need air circulation. But in case of aerobic treatment, the waste must be mixed in a weekly basis for better air circulation. So, the work needed for aerobic treatment is more than anaerobic treatment.

References

[1] Odum, E.P. (1977), Fundamentals of Ecology, W. B. Saunders company, London.
[2] Sharholy, M., Ahmed, K., Vaishya, R., Gupta, R., (2007), Municipal solid waste characteristics and management in Allahabad, India Waste management, 27 (4), 490-496
[3] Idris, A., Inane, B., Hassan, M.N., (2004) Overview of waste disposal and landfills /drums in Asian countries. Material Cycles and Waste management 16, 104-110
[4] Gupta, S., Choudhary, N and Alapet, B.J., (2007) Bioreactor Landfill for MSW Disposal in Delhi, proceedings of the international Conference on Sustainable Solid Waste Management, Chennai, India, pp. 474- 481.
[5] Jha, M.K., Sondhi, O.A.K., Pansare, M., 2003. Solid Waste Management- a case study. Indian Journal of Environmental Protection, 23 (10), 1153-1160.
[6] Johri, R and Rajeshwari K.V. Wealth from Waste: Trends and Technologies. The Energy and Resources India, New Delhi, India.
[7] WHO (2010), Solid Waste Management Challenges and its Health Issues.
[8] MoEF (1998), Biomedical Waste Management and Handling Rules, Ministry of Environment and Forests.
[9] MoEF (1998) Hazardous Waste Management Rules, Ministry of Environment and Forests
[10] H. Anandakumar and K. Unnamaneswari, A bio-inspired swarm intelligence technique for social aware cognitive radio handovers, Computers & Electrical Engineering, vol. 71, pp. 925–937, Oct. 2018. doi:10.1016/j.compeleceng.2017.09.016
[11] R. Arulmurugan and H. Anandakumar, Early Detection of Lung Cancer Using Wavelet Feature Descriptor and Feed Forward Back Propagation Neural Networks Classifier, Lecture Notes in Computational Vision and Biomechanics, pp. 103–110, 2018. doi:10.1007/978-3-319-71767-8_9
[12] Baschi A. Wiley and Hoboken, (2004), Design of Landfills and Integrated Solid Waste Management.