

STUDY ON SOLID WASTE HOME COMPOSTING PROCESS BY USING PIPING SYSTEM

Abhishek Raj*¹, Gagan RA*², Dhanush J*³, Darshan Patel*⁴,
Dr. GP Shivashankara*⁵

*^{1,2,3,4}Students Of Dayananda Sagar College Of Engineering, Karnataka, India.

*⁵Professor At Dayananda Sagar College Of Engineering, Karnataka, India.

DOI : <https://www.doi.org/10.56726/IRJMETS32812>

ABSTRACT

This paper represents a study on the home composting technique of solid waste generated at House hold. In the study we compare different methods which can be implemented into house hold composting for getting the best results. Most of the organic waste generated at homes end up in Landfill and turn into compost which can't be used anywhere. This compost, takes up space in landfill and sometimes also is a key contributor to fire hazards. Our solution to all this problem is to start composting at home using an economical model which will ease the composting process. The use of cow dung is easily available in India is used to start the composting process. With limited space in homes, our model uses vertical pipes which take up less space and can be used anywhere. The compost generated using the organic waste can be used as manure to grow plants. Using the Anerobic method to breakdown the waste, has a significant benefit of not producing lot bad odor. As the whole system is a closed model, the fly problem is also automatically tackled. The use of certain waste items can help in better composting rate and the quality of compost is improved. The generated compost properties will be studied in detail as well as the waste composition.

Keywords: Composting, Vertical Piping, Leachate Recirculation, Anerobic Digestion.

I. INTRODUCTION

Solid waste is a major problem that the world faces today. The magnitude of this problem needs to be given significant importance. Globally, 2 billion tons of waste is generated per year, this needs to be disposed safely without harming the environment.

The landfills currently used in India are not properly maintained and the dumping of waste is very unorganized. The waste collected is not properly segregated and all the waste ends up in landfill which is causing lot of problems like air pollution, water table infiltration, airborne diseases, etc.,

The waste generate at homes are usually organic waste and this can be easily composted. In order to prevent this waste to end up in landfills proper segregation of waste must be done, which will reduce the problem.

The segregated organic waste can be converted into nutrient rich manure which can be used to grow vegetable, flowers, etc., in the home. To make this happen we need to start composting and try and solve solid waste problem at the source level.

Our project aims to promote awareness and provide the required knowledge about how to solve the solid waste problem at the source level by providing a low-cost model to compost at home.

OBJECTIVES AND SCOPE

- To study the physical composition municipal wet solid waste.
- To develop a household system for the disposal of wet solid waste using vertical pipe with or without leachate circulation system.
- To assess the nutrient composition of composting material.

II. LITERATURE REVIEW

- **Effects of shredding of wastes on the treatment of municipal solid wastes (MSWs) in simulated anaerobic recycled reactors. (2005)**

In three simulated landfill anaerobic bioreactors, the effects of shredding on the anaerobic treatment of residential solid waste and leachate characteristics were examined. Leachate recirculation was used to operate each reactor. The findings of this investigation demonstrated that the breakdown of the organic component of

the solid wastes gathered from the kitchen has a favorable impact on the rate of biological degradation in anaerobic simulated recycling reactors.

➤ **Effects of bulking agents, load size or starter cultures in kitchen-waste composting. (2013)**

The study examined the effects of a bulking agent, newspaper, and onion peels, as well as composting waste loads of 2 and 6 kg, or the application of starting cultures, on the composting of kitchen trash composed of vegetable scraps and nitrogen-rich substrates. The findings imply that in-vessel composting of kitchen trash using onion peels alone can be effective with a minimal load of roughly 2 kg.

➤ **The Influence of Particle Size on the Performance of Anaerobic Digestion of Municipal Solid Waste. (2013)**

In order to improve the effectiveness of the biogas process, the study sought to ascertain the impact of particle size on the performance of anaerobic digestion of municipal solid waste. The pretreatment of substrates by the reduction of the size of the particles has improved the performance of the process and resulted in an increase in output of about 20% more for the particles of size 10 mm. The particle sizes of 10 mm, 20 mm, 30 mm, and 100 mm in diameter were examined.

➤ **Effects of microbial inoculation on composting of household organic waste using passive aeration bin. (2014)**

On the composting of home organic wastes, the effects of microbial inoculation with two commercial inoculants and mature compost were examined. Every day, the temperatures in each bin were noted. A composite sample of the compost from each bin was examined once every week to twice every week. In the unseeded and seeded bins, the C/N ratios of the composts stabilized at 81 days and 67-74 days, respectively. According to the study, adding commercial inoculants may not be essential to encourage the composting of domestic organic waste. To enhance composting, mature compost can be used as a seed starting.

➤ **Home composting versus industrial composting: Influence of composting system on compost quality with focus on compost stability. (2014)**

One of the most crucial characteristics of compost made from the organic portion of municipal solid waste is stability. This characteristic is crucial for the application of compost to land in order to, among other things, prevent additional field deterioration and odor emissions. This study presents a comprehensive assessment of compost samples obtained from both domestic producers and commercial facilities. Results are examined in terms of their chemical and respiratory characterizations, with the latter measuring the compost's stability. The study also emphasizes how vital respiration methods are to accurately characterizing the quality of compost.

➤ **Co-composting of various organic substrates from municipal solid waste using an on-site prototype vermicomposting reactor. (2016)**

We looked at a number of co-substrates for the vermicomposting process. These substances were, in order, dried cow dung (CD), kitchen waste (KW), sewage sludge (SS), and vegetable market waste (VW). In this study, the seven different MSW mixing ratios were examined; the compost produced by this method had greater nutritional levels than regular compost. The prototype vermicomposting reactor that was created could generate compost in accordance with the compost standard. Due to the high vermicomposting efficiency of this reactor, it can effectively provide value-added advantages for residential areas throughout the co-composting process.

➤ **Solid waste issue: Sources, composition, disposal, recycling, and valorization. (2018)**

One of the biggest issues facing urban environments today in the majority of nations is the collection and disposal of municipal solid waste (MSW). Solutions for MSW management must be technically practical, economically viable, socially and legally acceptable, and ecologically beneficial. The largest problem facing authorities in both small and large cities is solid waste management. Inadequate waste management alters ecosystems and contributes to air, water, and soil pollution, which poses a serious hazard to human health.

➤ **Pilot scale evaluation of a model to distinguish the rates of simultaneous anaerobic digestion, composting and methane oxidation in static waste beds. (2018)**

In this study, a model for estimating the rate and area of anaerobic soil was applied and validated. In order to determine the rates of anaerobic digestion, composting, and CH₄ oxidation, the rates of formation of CH₄, CO₂, ¹³C-CO₂, and O₂ were measured and utilized as inputs to mass balance equations for these components. CH₄ oxidation, composting, and digestion on lab-scale beds.

➤ **Effect of Leachate Circulation with Ex Situ Nitrification on Waste Decomposition and Nitrogen Removal for Early Stabilization of Fresh Refuse Landfill. (2019)**

The impacts of landfill stability under continuous leachate circulation after ex situ biological wastewater treatment in particular, a nitrified leachate circulation (NLC) system's nitrogen content and waste composition were compared to those of a leachate circulation (LC) alone system. For the early stabilization of trash landfills, we conducted leachate circulation tests utilizing pilot-scale landfills. By contrasting the LC, in which leachate was only circulated, and the NLC, in which nitrification was carried out using an ex-situ SBR and water that was treated by an SBR was circulated back to the landfill, the decomposition of waste and the removal of nitrogen in the landfills were specifically analyzed in detail.

➤ **Qualitative and quantitative characterization of municipal solid waste and the unexploited potential of green energy in Tunisia. (2019)**

There is a lack of information on the sizes and composition of waste streams, as well as an extensive overview and broader picture of the possibilities for MSWM that offers specific data at the regional and local levels. Because of this, the scientific community and the government are still unable to offer synergetic plans to link the issues with MSWM with how to incorporate practices that are both financially viable and environmentally sustainable.

➤ **Moderate separation of household kitchen waste towards global optimization of municipal solid waste management. (2020)**

The treatment of food waste by sorting is being explored progressively as a way to increase the sustainability of municipal solid waste (MSW) management, but the separation of home kitchen waste (HKW), which makes up the majority of food waste, is contentious due to its diverse origins. The HKW separation strategy is a crucial step in the reduction of carbon emissions, acidic gases, and energy consumption associated with MSW management. Complete HKW separation is the best HKW management method from an economic and environmental point of view, whereas mixed treatment without HKW separation has the lowest social cost when a significant length of time is taken into account.

➤ **Effect of Microbial Inoculum and Leachate Circulation on the Performance of Rotary Drum Composter Used for Household Wet Biodegradable Waste. (2021)**

Household wet biodegradable waste (HWBW) should be separated and treated at the source of generation to cut down on transportation costs and negative environmental effects. The findings showed that compost (20%) mixed with soil improved cress plant development. In addition, the rate of waste breakdown was forecast using a variety of kinetic models that were published in the literature. The efficacy of the rotating drum composter for HWBW treatment in continuous mode was established by the current investigation. It is possible to generate the sanitized compost with or without the inclusion of inoculum and leachate circulation. However, by adding inoculum, the time for active breakdown was shortened.

➤ **Dilution rate of compost leachate from different biowaste for the fertigation of vegetables. (2021)**

Leachate from compost is frequently handled like sewage. Due to the wide variety of nutrient concentrations, possible contaminants, and requirement for pretreatment before use, CL is used in agriculture. This study examined the properties of CL in terms of its nutrients and physical qualities from three different types of biowastes, including green waste, animal manure, and the organic part of municipal solid waste (OP-MSW). To enable the conversion of CL into an organic liquid fertilizer for agricultural use, a dilution technique must be designed. In this work, three biowastes—organic municipal solid waste (OP-MSW), animal waste, and green waste—were used as case studies to characterize the physical, macronutrient, and micronutrient features of composting leachate (CL). Most analyses show the over-limits of COD, macro- and micronutrient concentration for CL to be applied directly as fertigation water, notably the CL from the OP-MSW.

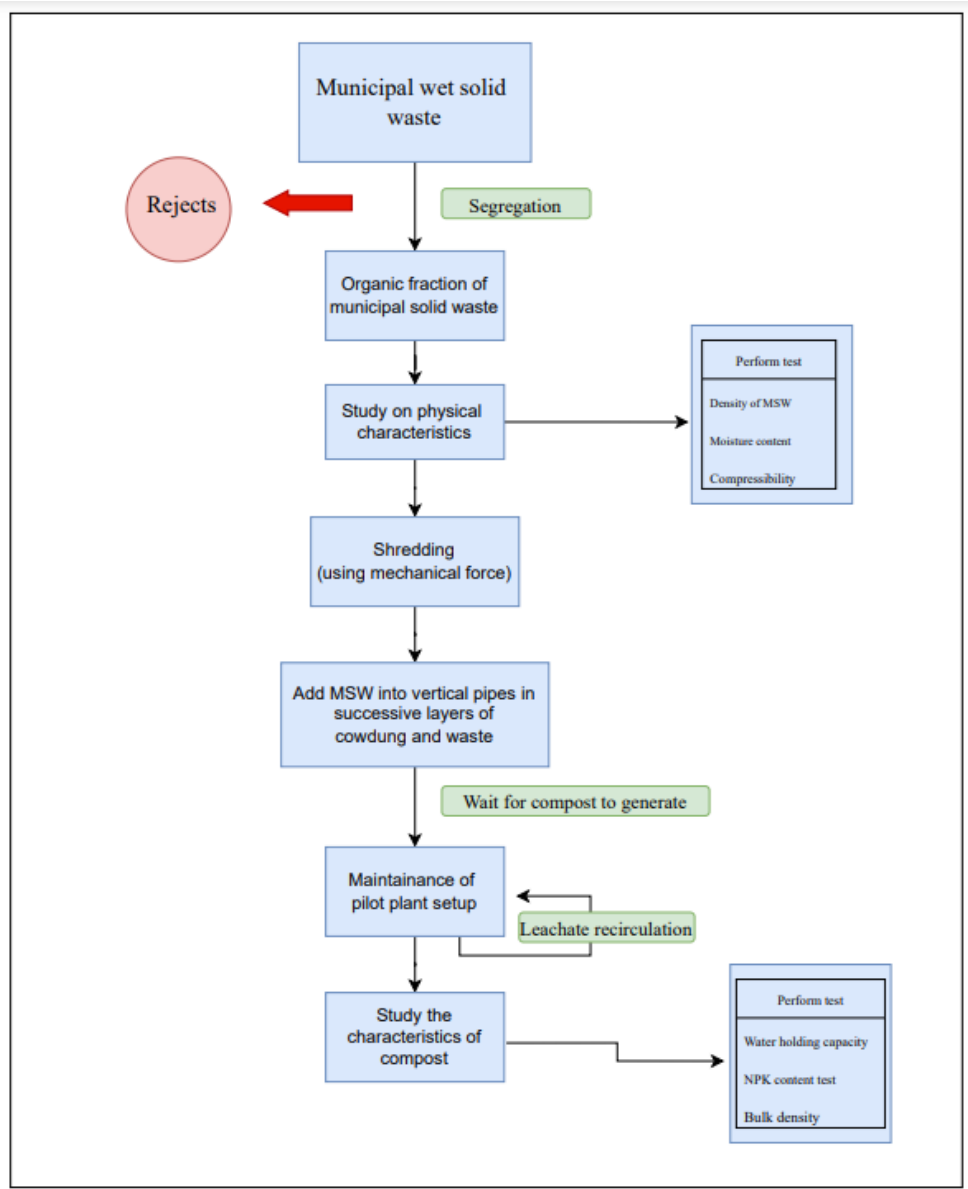
➤ **Strategies for resource recovery from the organic fraction of municipal solid waste. (2021)**

Large amounts of municipal solid waste (MSW) are being generated in metropolitan areas as a result of rapid population increase and urbanization. Up to 57% of the municipal garbage produced worldwide is represented by the organic component of municipal solid waste (OFMSW). Resource recovery from OFMSW is now required in the context of creating a bio-based circular economy. This paper outlines the many processes, including anaerobic digestion, composting, hydrothermal carbonization, pyrolysis, and landfilling, that are utilized in practice to recover important resources (such as bio-oil, biochar, and biomethane) from OFMSW.

➤ **Regulating bacterial dynamics by lime addition to enhance kitchen waste composting. (2021)**

This study used modular network analysis to evaluate the bacterial dynamics in response to lime addition to improve composting of kitchen trash. Three meta-modules of bacterial communities that correlate to the mesophilic, thermophilic, and mature stages of composting may be identified. Acidogens and denitrifiers were decreased by the addition of lime at 1% (wet weight). The findings of this study show that lime may control both biotic and abiotic processes to enhance composting of kitchen garbage. Lime reduced acidogens and denitrifiers, which were the dominating bacteria in the mesophilic stage, to lower GHG emission, according to modular network analysis.

III. METHODOLOGY



IV. CONCLUSION

Waste management is one of the most significant environmental issues the world is now facing. The focus now is on cutting waste and product acquisition costs. The garbage produced at houses ought to be turned into something beneficial. People need to be made aware of the need to limit waste output and provided with the information they need to compost at home. The amount of organic waste dumped at landfills can have a significant influence on waste management. We can lessen the current waste issue in our nation by turning waste into useful material at the source. We will be further assisted in composting at homes, which will be an inexpensive approach, by modelling a pilot plant setup.

V. REFERENCES

- [1] Abdel-Shafy, H. I., & Mansour, M. S. M. (2018). Solid waste issue: Sources, composition, disposal, recycling, and valorization. *Egyptian Journal of Petroleum*.
- [2] Abdullah, N., Chin, N. L., Mokhtar, M. N., & Taip, F. S. (2013). Effects of bulking agents, load size or starter cultures in kitchen-waste composting. *International Journal Of Recycling of Organic Waste in Agriculture*, 2(1), 3.
- [3] Ahamad Sanadi, N. F. B., Ibrahim, N., Ong, P. Y., Klemeš, J. J., Li, C., & Lee, C. T. (2021). Dilution rate of compost leachate from different biowaste for the fertigation of vegetables. *Journal of Environmental Management*, 295, 113010.
- [4] Babu, R., Prieto Veramendi, P. M., & Rene, E. R. (2021). Strategies for resource recovery from the organic fraction of municipal solid waste. *Case Studies in Chemical and Environmental Engineering*, 3, 100098.
- [5] Bae, W., Kim, S., Lee, J., & Chung, J. (2019). Effect of Leachate Circulation with Ex Situ Nitrification on Waste Decomposition and Nitrogen Removal for Early Stabilization of Fresh Refuse Landfill. *Journal of Hazardous Materials*.
- [6] Barrena, R., Font, X., Gabarrell, X., & Sánchez, A. (2014). Home composting versus industrial composting: Influence of composting system on compost quality with focus on compost stability. *Waste Management*, 34(7), 1109–1116.
- [7] Hajji, A., & Rhachi, M. (2013). The Influence of Particle Size on the Performance of Anaerobic Digestion of Municipal Solid Waste. *Energy Procedia*, 36, 515–520.
- [8] Karnchanawong, S., & Nissaikla, S. (2014). Effects of microbial inoculation on composting of household organic waste using passive aeration bin. *International Journal of Recycling of Organic Waste in Agriculture*, 3(4), 113–119.
- [9] Manu, M. K., Kumar, R., & Garg, A. (2021). Effect of Microbial Inoculum and Leachate Circulation on the Performance of Rotary Drum Composter Used for Household Wet Biodegradable Waste. *Waste and Biomass Valorization*, 12(11), 6119–6137.
- [10] Rafiee, R., Obersky, L., Xie, S., & Clarke, W. P. (2018). Pilot scale evaluation of a model to distinguish the rates of simultaneous anaerobic digestion, composting and methane oxidation in static waste beds. *Waste Management*, 71, 156–163.
- [11] Sponza, D. T., & Ağdağ, O. N. (2005). Effects of shredding of wastes on the treatment of municipal solid wastes (MSWs) in simulated anaerobic recycled reactors. *Enzyme and Microbial Technology*, 36(1), 25–33.
- [12] Taeporamaysamai, O., & Ratanatamskul, C. (2016). Co-composting of various organic substrates from municipal solid waste using an on-site prototype vermicomposting reactor. *International Biodeterioration & Biodegradation*, 113, 357–366.
- [13] Wafi, T., Ben Othman, A., & Besbes, M. (2019). Qualitative and quantitative characterization of municipal solid waste and the unexploited potential of green energy in Tunisia. *Bioresources and Bioprocessing*, 6(1).
- [14] Xu, Z., Qi, C., Zhang, L., Ma, Y., Li, G., Nghiem, L. D., & Luo, W. (2021). Regulating bacterial dynamics by lime addition to enhance kitchen waste composting. *Bioresource Technology*, 341, 125749.
- [15] Yu, Q., & Li, H. (2020). Moderate separation of household kitchen waste towards global optimization of municipal solid waste management. *Journal of Cleaner Production*, 123330.