Anaerobic Treatment for Degradation and Stabilization of MSWOF with post compost Maturity

Mr. Joshi Dinesh B.[1], Dr. More A. B.[2]
[1] Department of Technology
[2] Department of Civil Engineering
[1] SPPU, Pune, India
[2] PVPIT, Bhavdhan, Pune, India

Abstract- *Decomposition is a complex and continuous process whereby the multiple type of biological material reduced to its mineral form. It can be characterised by many physical, chemical and biological processes.*

Degradation is process of biotic decomposition of substance means the metabolic breakdown of materials into simpler components by living organism, typically by microorganisms like bacteria, fungi, and protozoa. In decomposition, different products released; carbon dioxide, energy, water, plants nutrients and resynthesized organic carbon compound. The decomposition by microorganism takes in either aerobic or anaerobic conditions.

Anaerobic decomposition is a process by which a complex mixture of symbiotic microorganism transform the organic material under oxygen free conditions, and it's a process by which a complex mixture of symbiotic microorganism transform the organic material under oxygen free conditions. In anaerobic decomposition which mainly consist of Hydrolysis /liquefaction, acidification (Acid phase) and Acetogenesis, Metanogeesis (methane phase).

Composting is the major source for material recovery and digestion majorly used for energy recover. In acid phase of anaerobic process, Liquefaction and depolymerisation of organic matter. During hydrolysis, complex insoluble substrates are hydrolysed in smaller units by large numbers of hydrolytic microorganism.

Aerobic composting process degrades organic waste into humus like stable product using aerobic microorganism under moist and self-heating condition. The degraded and hydrolysed material pre-treated with the anaerobic treatments step up the process of composting. In addition, reduces the process time with enhancement of nutrients restoration.

Keywords- Anaerobic, wet waste, aerobic, composting, hydrolysis, stabilization.

I. INTRODUCTION

In most of metros in Indian cities at present, the solid waste management is being a critical issue and management of wet waste is the key domain in the overall process of solid waste management. At present at pune and PCMC, almost 1800MT of domestic waste is collecting and 600MT is the part of wet waste. To get rid from the issue the PMC has asked to co-op societies to manage their own waste anyhow. The options available are-

1. Aerobic composting.
2. Digestion and energy production.
3. Supply to piggery farms.
4. Waste solidification and incineration- Briquettes from Organic Waste.

From above composting is the most suitable method in present scenario, but as the development of constructions was happened without planning and considerations of ref aspect, create additional space for aerobic composting is big deal for owners, also the citizens are reluctant to spare the available space being ignorant in ref of waste management.

Now to stop the valuable biomass being just dumped in landfilling with huge transporting cost with havoc creation in around of dumping yards, space friendly compact solution without consumption of electrical/fuel energy in minimum installation /maintenance/operational cost with earning the benefits of wet waste as resource to convert it as a manure for soil enrichments and economical sustenance/promotion of process, we are aiming to develop the system of anaerobic composting of wet waste.

Following points will elaborate the background of need of thesis.

A. Solid waste management – Decentralized solid waste management is the need of time at present for Indian metro cities as we are facing the issues of centralized waste management process. In future, it seems not possible to get the lands for land filling as the problems arising through present handling.

B. Let honour the 80:20 rule- Though the developed technology available which are based on high cost investment and energy hungry its implementation and maintenance in the view of economic investment and willingness of citizens, the quantum of total wet waste management not possible to cross 20% of present quantity and most 80% of quantum will be un attended and same can be addressed with low cost/energy based process of composting.
C. Soil enrichment – Since the era of Second World War and big agriculture revolution of India after 1970, the use of agrochemical fertilizers followed with pesticides broken the backbone of Indian eco nature friendly organic farming and the need of organic farming with soil replenishment is the need of time.
D. Let Close the loop – Conversion of organic waste to resource can close the loop and cycle of eco –agro process.

II. LITERATURE REVIEW

1. Objectives of the process-

A. To stabilize the organic matter (MSWOF) through anaerobic process using leachate recycling in mesophilic condition and post composting same for maturity in simple aerobic condition.
B. Quantifying the biochemical parameters of the product.
C. Deciding and quantifying the stability of the product.
D. Techno commercial aspect assessment of the process.

2. Literature survey –

To work on Objectives, we did the literature survey and from survey, we found following important references to relate the objectives.

First literature - Anaerobic composting of solid waste in batch load in digesters.

Waste generated in a community can be a valuable energy and material resource, current waste disposal practices consumes energy and have led this resource to become a serious environmental burden as many areas landfill sites are on verge to close and difficult to get new sites. Anaerobic composting for recycling the biodegradable MSWOF is good option for waste disposal. Its decompositions that occurs using microorganism that do not requires oxygen. There is thin line in anaerobic & aerobic composting in contrast to wastewater treatment.

The objective of this study was to study the anaerobic composting process for the MSWOF and this study investigated the potential of anaerobic composting as safe disposal method for it.

For two waste combinations on the four samples, the rate of composting was compared with analysis of physical, chemical, and biological characteristics at start and end of process to evaluate the suitability of product –compost as a soil conditioner based on the bacterial die off and changes in other characteristics.

An experimental set up of eight brick digesters for two combination x 4 periods with proper cover and water seal and Gas outlet in the cover provided. All eight digesters were used for first run, then group of two digesters were opened in succession of 20, 40, 60, and 90days. At this time, each group refilled with respective waste combination to initiate run II, III & IV. Run I were carried out at 20, 40, and 60 days' milestones, however rest three runs parameter analysed only at beginning and end of the run only.

Conclusive readings and noting –

Temperature was low around 27*c high at initial grown to 54*c within first 28 hours of composting then stabilized to 31*c.

1. pH increased in process and reached at ends about 6-8.
2. Moisture content reduced 68 % to 47 % at end.
3. % C reduced to 22% from 41%.
4. % N – was in span from 1.34 to 1.73 ended with 1.45
5. C/N ratio reduced 31 to 16.
6. % P – increased from .13 to .21.
7. Total Coliform declined negligible at the end of 90 days.

The decreasing rate of Carbon content and C/N ratio indication seems. Composting process progressed, the C/N ratio during the first run varied, The C/N ratio was 30.35 at the beginning and decreased to 29.19, 27.16, 22.37, and 18.54 after the intervals of 20, 40, 60, and 90 days, respectively.

Anaerobic composting for recycling the biodegradable organic fraction of solid wastes are one good option for waste disposal. Although, anaerobic digestion of organic waste is also catching attention due to the high-energy recovery, anaerobic composting may score higher due to the several factors. One of them is that the effluents from anaerobic digestion are not generally suitable for putting directly onto land. Post-treatment after anaerobic digestion is needed to obtain high quality, finished product. Thus, compared to anaerobic composting, anaerobic digestion is a

complex process that requires larger investment, On the other hand, the end Product of anaerobic composing of organic waste is directly applicable on land. Based on the results of this study, it could be concluded that anaerobic composting of the organic fractions of municipal solid waste could not only be a safe disposal method but also would provide a useful end product-compost. Further study needed to evaluate the suitability of anaerobic composting for other organic waste compositions under a range of climates.

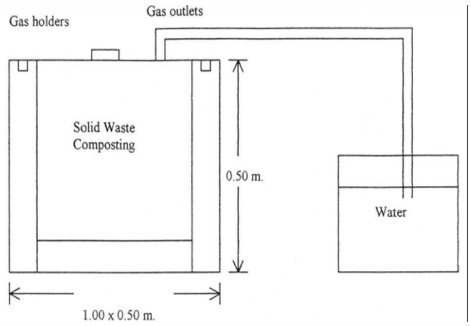

Figure 1. Schematic setup for anaerobic composting.

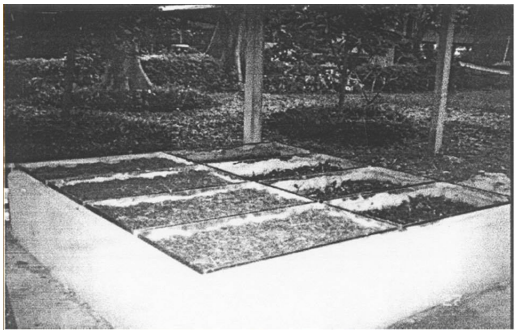

Figure 2. Actual photograph of setup.

Second Literature

From - www.less is more.org (Non Experimental process using two-bin system)

In this reference, they suggested to use two anaerobic composting bins should be used to allow for continuous composting. While one is finishing composting, the other can be filled. If you plan to construct a homemade composting bin, be sure to choose a bottomless barrel with a lid that seals tightly and has a capacity of 35 gallons or more (see Section 5). An anaerobic composting bin should be located in a spot with good drainage. Accessibility, aesthetics, and convenience should also influence where your bin is placed. If located under or next to fruit trees, they will benefit from the added moisture and nutrients. To prevent the contamination of water, avoid a bin location near waterways or drainage courses. To prepare the site, dig a hole 6 to 12 inches deep, set the bin into the hole, and pack the ground firmly around the bin. Lining the bottom of your bin with. -inch poultry wire will fortify it from scavengers but still allow earthworms to enter.

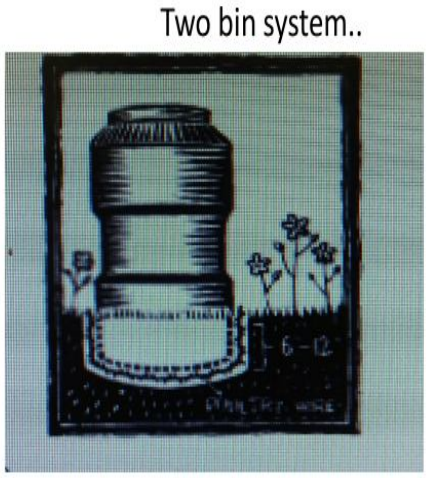

Figure 3. Schematic sketch for two-bin system.

Third Literature

Investigation of Biological process aimed at improving the quality of compost from bio waste.

MSW generated, if properly processed it can be an important means for contributing to the restoration of carbon sink in soil and for substituting mineral fertilizers. Anaerobic Digestion (AD) can be used as diffused technique for recovering material (e.g. nutrient and organic carbon) and energy from bio-waste. Biological treatment aimed at material recovery from the bio waste should generate compost with a high, but also a stable organic matter content.

As there is lack of information on how anaerobic pre -treatment can perform in production of compost, the pilot run experimental setup helps in ref investigations.
In ref experiment

1) SADB (solid anaerobic digester batch) for 30 days + Post composting treatment test 60days total -90 days.
2) SADB 30 Days + Inoculum 60days + Post composting total -90dyas and 3) only composting -90 Days.

Total six runs performed, three were for pure composting and SADB + PC and three were for pure composting and SADB +Inoculum + Post composting.

The results indicated that the quality of the amendment in term of TOC, HA& FA (Homicide and felvic acid) content was higher for the integrated SADB treatment W.R.T. both SADBPC-I, and composting.

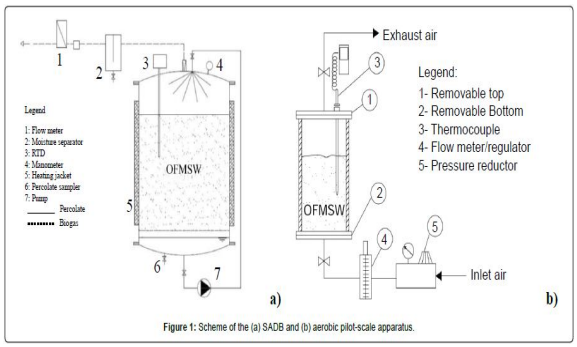

Figure 4. Details of process set up for aerobic pre-treatment and process flow diagram

The present study showed how non-intensive anaerobic digestion pre-treatment results in digested bio waste with balanced concentration of less and rapidly biodegradable organic compounds able to increase the quality of compost after a post composting –phase.

Fourth Literature

Microbial means of bio waste management – Microbial means utilizing the microorganism to degrade organic waste to produce compost. The aerobic digestion and biogas through anaerobic digestion. A community specific approach can be applied to recycling of garbage and different types of the methods employed. Also above methods need to be explored for their compatibilities use with minimum nuisance value.

The compost may find its way to the market if its quality is assured, quantifiable and can be measured and certified through appropriate assurance system. Compost stability constitutes an important and probably the most controversial aspect of overall compost quality in terms of definition and evaluation in this context, it is important to better understand the dynamic of the process and assess the rate and the degree of the organic matter decomposition (compost stability).

From organic waste carbohydrates, proteins and fats are very susceptible to decomposition (sugars, starch, pectin's, fatty acids, lipids, amino acids & Nucleic acids) whereas Hemicellulose, cellulose and lignin are having more resistant's to decomposition and mineral matters mainly unaffected by the process.

Aerobic digestion – aerobic digestion process degrades organic waste into humus like stable product using aerobic – microorganism under moist and self-heating condition. Oxygen (Air), temp and moisture are main pillars, temperature rise is important for a public health as pathogens in the compost destroyed during thermophilic condition.

A typical composting process goes through a series of phases, including a rapid temperature rise, sustained high temperature and gradual cooling down of composting mass. Compost stability is an important aspect of compost quality, determining compost nuisance potential, nitrogen immobilization and leaching and phytotoxicity.

Compost is sufficiently stabilized when the rates of oxygen is reduced to the point in which anaerobic or foul-smelling conditions are not created to an extent that they interface with the storage, marketing and use of the product. In addition, stabilized compost should not have problem of vermin attraction, Pathogen regrowth or other problem resulting from its incomplete decomposition.

Anaerobic digestion – During anaerobic digestion, organic matters is converted to CO2 & CH4, the AD process converts carbohydrates, protein and fats from bio-waste through hydrolysis, acidogensis, acetogensis, and methenogenisis. During the process, not all the organic matters are completely degraded and ends up in residual product(digestate), which is also rich inorganic nutrients, this makes the digestate an excellent complement to manure and commercial fertilizers on agriculture soil, provided pathogens controlled to be addressed.

It should be the aim of the microbiologist to know the diversity of microbes present in a certain system and their specific roles in achieving the desired target.

Fifth literature

Novel process for anaerobic composting of MSW. (Applied biochemistry and biotechnology vol 28/29, 1991.

The sequential batch anaerobic composting (SEBAC) process employs leachate management to provide organism, moisture, and nutrients required for rapid conversion of MSW. The multistage leachate recycles type sequential batch anaerobic composting (SEBAC) reactor tested the two-diff feedstock for two diff retention times.

Stage 1- leachate from old stage recycled to new stage, same also removes inhibitory organics produced in stage I from DE polymerization and fermentation reaction.
Stage 2- The fermentation is active, balanced, and thus operated in batch mode.

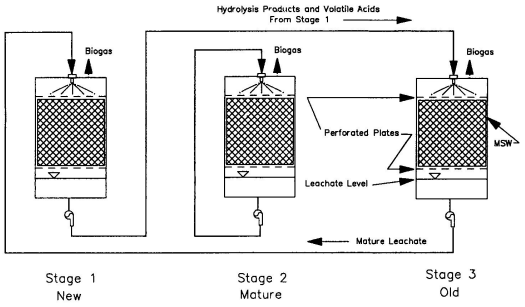

Fig. 1. Schematic diagram of the sequential-batch anaerobic composting (SEBAC) process.

Figure 5. Schematic process flow diagram for Novel process for anaerobic composting.

During the test methane gas content rapidly increased after 5days, indicating developing of balanced methane fermentation. During these stage acids were converted to methane and Co2, another important observations is that these runs were very stable by virtue of the removal of inhibitory volatile fatty acids formed during start up.

The SEBAC designs are expected to be competitive because of simplicity of design and high stability and lack or movement of solids during operations. The design is versatile and could be applied to either in vessel system or modified landfill designs. The latter applications are compatible with newer landfill designs requiring leachate management & treatment.

III. METHODOLOGY TO BE OPTED

To work on objectives, and based on literature survey, we decided to set up the combination of both principles.

At first use anaerobic pre-treatment and then to go for aerobic post composting maturity. In addition, for it we draft out process outline Design and process setup preparation, deciding parameters to be measured with raw and processed material, Defining Batch, volume.

IV. RESULTS AND TABLES

1) Based on literature survey we noted following important point in reference of –

Anaerobic digestion Vs Composting.

1. It is generally accepted that post treatment after anaerobic digestion needed to obtain a high quality, finished product.
2. It is also true that anaerobic tech requires larger investment and monitoring.
3. Different emissions of volatile compounds during aerobic composting need to be monitored.
4. Digestion mostly get used for energy recovery and less for manure production.

2) Following Important Parameters will going to govern with composting process.

Temperature, moisture, Total solids, Total volatile solids, C/N Ratio, Total Nitrogen, pH, Phosphors, Toxicity etc.

V. CONCLUSION

In reference wet organic waste, Biological processes can employed in view of resource recovery in the form of energy and material. Anaerobic process is most widely used for energy recovery and aerobic process mostly used for composting. In processes using both principles, various physical, chemical and biological pre-treatments being used. In addition, there are strengths and weakness of every systems. Applying combinations of both treatments, the overall process of resource recovery can achieved. Employing anaerobic pre-treatment, we can achieve hydrolysis and degradation of MSWOF in a closed loop vessel in shorter space with limiting the emissions of volatile organic compounds with nutrients restoration.

Using anaerobic pre-treatment, we can go for aerobic post composting maturity process to get the stabilized compost, which could be the rich soil amendment. So addressing the space constraints of existing housing society with minimum or no power consumption, set up of easy handling process could deliver the solution for today's crises of solid waste management issue.

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