

# Enriched Rapid Composting Techniques for Agro Industrial Organic Solid Waste



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**Abstract:** *The main aim of this project based paper is to provide technological solution for composting process with will help to minimize the composting process and the technology will be easy to adopt. We are facing waste management problems in all areas. Agriculture and Industrial waste management is one of them. There are lot of methodologies available in the market for processing the raw material and making compost. The various methods differ location to location and season to season. The researchers are doing continuous research on the process optimization and to find minimum time to produce compost. Thus, a sound technology is required to improve the quality of manures in the shortest possible time, where farmers can prepare the compost easily and improve its nutritional quality by the addition of cheap amendments as additives in composting. Therefore appropriate composting technology which is economically viable, eco-friendly and socially acceptable is essential. Development of Rapid composting techniques to produce organic fertilizers will help to minimize soil pollution due to chemical fertilizers and will help in Agricultural and Industrial organic solid waste management. We have done few experiments on accelerating composting processes. Use of activated sludge with other additives have helped to improve compost process time and its nutrients. In this paper we have given detail methodology and results obtained from the experiments.*

**Keywords:** *Organic Manure, Rapid Composting, Additives in compost. Organic waste management.*

## I. INTRODUCTION

The main aim of this project is provide technological solution for composting process with will help to minimize the composting process and the technology will be easy to adopt. The data was collected from various sources and studied. Technical papers from reputed journals downloaded from Internet. Various reference books were used for the study. PowerPoint presentations related to composting process mechanics, Technologies and financial feasibility's are studied. We are facing the problem of organic solid waste management of industrial and agricultural industries. Recent waste management rules are applied and it is prime responsibility of user to dispose the waste. There are lot of methodologies available in the market for processing the raw material and making compost. The various methods differ location to location and season to season. The researchers are doing continuous research on the process optimization and to find minimum time to produce compost. After studying from

various resources related to composting technology It was decided that further study should be done with considering following points -

1. The composting process time should be minimized. For organic waste.
2. The available co-composting material should be used as additives.
3. The clues and un-explored parameters related to rapid composting indicated from the literature study should be further studied and experimented.

With consideration of above points or parameters the proposed experimental process was designed. The various combinations of raw organic waste were worked out. It was decided to add few attitudes with various combinations. The purpose of additives was to help enhancing the composting process. The additives will play a role as a food for rapidly growing microorganisms.

## II. LITERATURE REVIEW

More than 20 technical papers were studied related to Rapid composting techniques. From these papers following points are noted and considered for deciding proposed methodology.

- Choose equipment and management methods based on your location and the intended use of the finished product.
- Determine the right mix of ingredients to optimize C:N ratio, moisture content and porosity.
- Monitor the composting process: temperature, oxygen, moisture and odours.
- Effect of additives on composting enhancement is useful and will lead to innovative idea for future research works.
- Sugar as a carbon source can promote the growth of degrading microbes and will accelerate composting process.

Based on literature study from various sources it was found that use of Activated sludge, Jaggery, Grain Powder etc can be experimented for rapid composting process. As activated sludge contains bio-microbes and jiggery and grain powder can be good food for enhancing the microbiological growth.

## III. METHODOLOGY

### A. Outline of Proposed Experiment

Based on study and literature findings it was decided to conduct experiments on five type of waste samples. The waste samples collected from Agricultural and Industrial factor,s the samples were organic nature as the test experiments restricted to organic solid waste only.

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Additives were added in the samples for enhancing the compost process. The role of additives in the experiment was to accelerate the decomposing procedure, to provide additional food for microbes and to formation of new microbes which will be attacking on raw material for decomposing it in shortest possible time. Following type of wastes samples used for the experiment purpose.

1. Agriculture waste from Farmers Cow Shed.
2. Market waste form Canteen Kitchen area.
3. Organic waste like tree/bushes leaves, branches and street collection from Housekeeping department of Tata Motors.
4. Garden Waste from Horticulture department.
5. All Above equally mixed

To enhance composting process we decided to add following few additives.

- Jaggery – Food for micro-organisms
- Single Super Phosphate – To Enhance composting Process.
- Activated Sludge – Readily available Micro-Organisms
- Grain Powder – Food for Micro-Organisms
- Bio-Culture – Readily available culture.

The quantity of Jaggery, SSP and Grain Powder decided to be taken as 1% of sample that worked out is 100 grams each. During trial observations it was found that the required quantity of activated sludge was less for green waste. Approx. 5 lit quantity required to wet and moist the green waste whereas 10 lit quantity required to dry waste. 500 gm bio-culture used in each compartment for initial starter.

#### B. Proposed Combinations for Waste Samples

First trial run was not successful, the maturity was not achieved. Quantity of raw material was less hence quantity doubled as 10 kg which showed significant improvement in maturity time.

All the five category waste samples were tested under three groups.

- With all additives.
- With Sludge and Bio-Culture.
- Without additives.

#### C. Set-up arrangement for Experiments

Two setups made for running parallel trials at a time. Brick work 100 mm thk made up to 600 mm height. Longitudinal distance between two walls was 600 mm while short cross walls constructed at 700 mm distance. The final size of compartment was 600 x 700 x 600 deep.



**Pic -1 Actual Photograph of Test Setup**

Considering air requirement for composting process, the wall was constructed as permeable with weak joints. As this was experiment setup we did not provided big holes like the Nadep recommendations (N.D. Pandharipande) of making compost. The reason for this was samples should not get wasted from these holes and accurate measurements possible. The entire setup was covered with green cloths for protecting

it from direct sunlight entry and to maintain the moisture content.

#### D. Preparation for Trials

For making good quality compost, sample preparation should be given prior importance. The shape and size of ingredients material affects the time of composting. In any type of materials chemical reaction depends on particle size. Smaller the size chemical reaction becomes faster as surface area available for reaction increases. All the samples were shredded. While preparing sample for composting following precautions taken –

- Raw samples checked and foreign material other than parent material removed.
- Sample mixed homogenously to form one material.
- Raw material shredded using shredding machine and converted them into small particles.
- Samples filled in bags and weighed on electronic machine.



**Pic -2 Picture of Shredding Process for Waste Samples**



**Pic -3 Samples Looking after Shredding**

#### E. Initial Trial Runs – Learnings

As mentioned above about sample preparation the fifteen samples were prepared with combination of various raw wastes. The samples placed in compartments. To maintain optimum moisture content, after five days water added at required quantity such that material will remain in moist condition. Turning and mixing of samples done at every fifth day after adding water. Temperature noted one time evening at an end of the day.

Learnings from the first trial run –

1. Continuous monitoring of moisture level is required.
2. As temperature showing variation means the process was not continuous. Mixing of material should be done periodically.
3. Due to temperature rise in summer the process affected much more. The grey/brown samples observed dried frequently because of less water availability.

4. Green samples were decomposing properly.
5. Need to protect test setup from direct sunlight.
6. As trial run taken in April month lot of heat was there, the moisture content was not monitored properly needs improvement.

**F. Final Three Trials**

Based on observations and learnings from first trial run the improvements were done in next experiment trial. More attention was provided on watering, mixing, turning and continuous monitoring. Second and third trial runs was parallel. Following precautions were taken while this trial run –

1. Temperature noted twice a day – between 10-11 AM at morning and 5-6 PM at evening.
2. Checking of moisture content done after every two days.
3. Mixing and turning done after every two days.
4. The test setup covered with Green Cloth to maintain shadow and protection from sunlight.

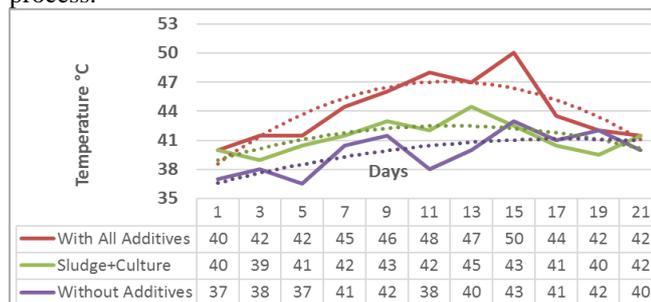
**IV. RESULT AND DISCUSSION**

Three trial runs were carried out to check final outcome of the experiment. Green waste like Market yard waste, Garden Grass etc started changing color after 2-3 days. At the time when five days over leachate formation in green samples especially at market waste was observed hence additional water was not added at these compartments. Grey dry grass and Agricultural waste from cattle house was demanding more water as it was drying immediately after two day. We maintained moisture content as well as shadow by providing green canvas cloth covering Test Setup. Turning of samples were done whenever required to maintain oxygen level and for free oxygen availability for microorganisms. Approximate time required for composting process was 21 days with additives samples. Samples without any additives did not composted within 21 days hence they were kept for two months and then tested for parameters.

**A. In Process Test Results**

**Volume:** -It was observed that there was highest rate reduction in volume 41% for the sample treated with all additives. On the other hand it clearly indicates that the sample's treated without additives were having less reduction in volume. Under this category also green waste shows more reduction in volume as compared to other samples. Samples in Brown category are having less reduction in volume after 3 weeks observation.

**Temperature:** - Average temperature of all readings was observed height up to 48 deg between 11<sup>th</sup> to 15 days. Temperature observations shows that samples with additives were showing good graph indicating proper decomposing process.



**Graph-1 Day Wise Average Temperature Profile**

**pH (potential of hydrogen ions): -**

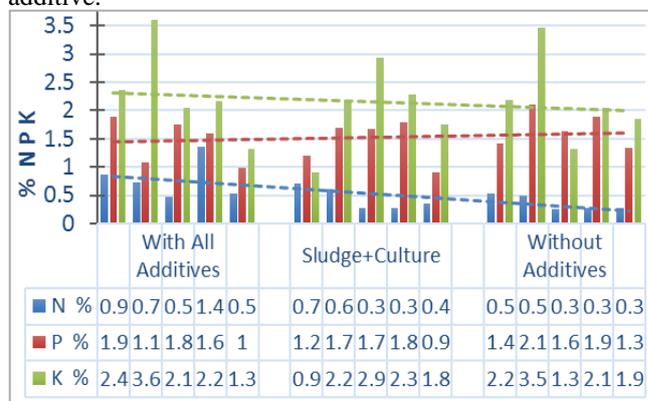
**Samples With All Additives** - pH for all samples showing reducing trend from initial 8-8.5 to 6 till 21 days period. Initial pH drop was seen more predominant for samples treated with all additives. This was indicating that proper decomposing process has been initiated.

**Samples Sludge + Culture** - For these samples there was no drop in pH till 9<sup>th</sup> day which indicated slow or inadequate decomposing process. After 9<sup>th</sup> day within 3-4 days it was dropped to 6 indicating start of process.

**Samples Without Additives** – These samples were not decomposed after 21 days still shown down trend for pH.

**B. NPK Combine – Nitrogen, Phosphorous, Potassium**

Table with graphs shows the combine trends of NPK content from the samples. The trend line of Phosphorus (P) is flat in nature whereas, The trend of graph showing Nitrogen (N) content in the tested samples shown reducing in nature. Nitrogen content is higher in nature as compared to other nature samples. This may be due to use of activated sludge as additive.

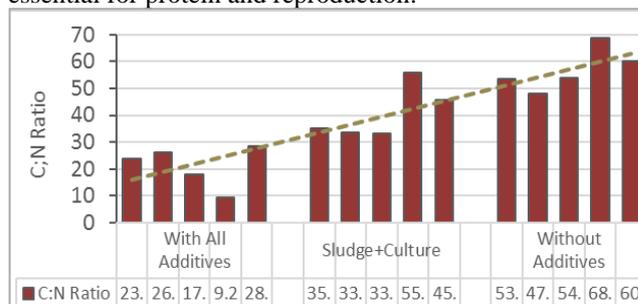


**Graph-2 Day wise Average Temperature Profile**

The trend line from our graphs shows reducing trend towards without additives added samples. This may be due to availability of additional potassium from additives like activated sludge and jiggery etc. In short we can say Nitrogen and Potassium are in high content at samples which are treated with our method.

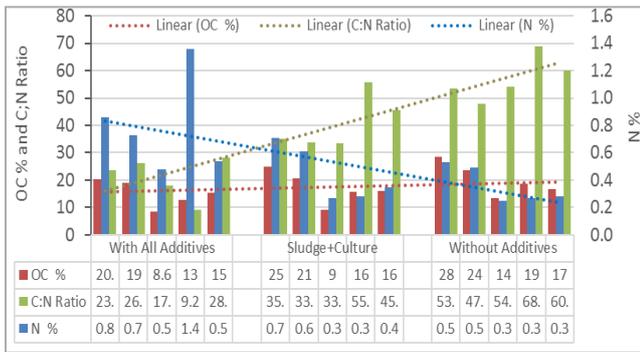
**C. C:N Ratio**

Many organic materials contain enough quantities of nutrients for composting. Excessive or insufficient carbon or nitrogen will affect the process. Carbon provides microorganisms with both energy and growth; nitrogen is essential for protein and reproduction.



**Graph-3 C:N Ratio & Its Trend**





**Graph-4 Organic Carbon, Nitrogen and C:N Ratio & Their Trends.**

The Graphs shows increasing trend for C:N ratio it is due to samples are not fully decomposed. With all additives samples decomposed within 21 days resulting C:N ratio is less. Organic Carbon is same for all samples where as Nitrogen showing redecing trend line means high Nitrogen for samples treated with additives. It shows clear indication of use of additives like Activated Sludge, Jaggery, Grain Powder etc has given good impact on Nitrogen content. And C:N ratio for these samples are good after testing it for 21 days.

## V. CONCLUSION

There are lot of methods available in the market for processing the raw material and making compost. These methods may differ location to location and season to season. After studying from various resources related to composting technology. Parameters for the proposed experimental process was designed. The purpose of additives was to help enhancing the composting process.

Following points are summarized as conclusion.

- The samples treated with additives like Activated sludge, Jaggery, Grain Powder and bio-culture observed rapidly decomposed within 3 weeks. The samples treated with only activated sludge and bio-culture observed fairly decomposed at the end of 3 weeks.
- Change in volume for samples tested with all additives was rapid as compared to other samples. Also temperature for these category samples was highest in between 13<sup>th</sup> to 15<sup>th</sup> day and then gradually dropped at the same time after two weeks pH was acidic in nature this indicates smooth process of composting.
- Average C:N ratio 19.22 clear indicate that use of additives like Activated Sludge, Jaggery, Grain Powder etc has given good impact on Nitrogen content. After 21 days test this group of samples shown very good C:N ration.
- Nitrogen (N) and Potassium (K) content of samples have improved for additives composting.
- Activated sludge can be successfully used for rapid composting. It is helping to process and adding nutrient values. In the industrial and agricultural organic waste management area we can use Activated sludge, Single Super Phosphate, Jaggery and Grain Powder for fastening the composting process.

Considering above all real factors from experiment we can conclude that Activated sludge can be used for rapid composting process. Jaggery, Grain Powder, Single super Phosphate and Bio-Culture can be combinely used for effective rapid composting process. Using this method we can down the composting process time within 3 weeks.

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