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Effective utilization of microorganisms in decomposal of soild waste

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ABSTRACT

EM or Effective Microorganisms is a microbial inoculant containing many kinds of naturally occurring beneficial microbes. Maple EM-1(Expired and Non-Expired) is activated using ricewater and jaggery separately. Fruit and vegetable wastes were collected and inoculated with Activated Non expired Jaggery EM, Activated Non expired Rice water EM, Activated Expired Jaggery EM and Activated Expired Rice water EM respectively. The physical (Odour, Appearance and Colour) chemical (pH, Salinity, Conductivity, TDS, DO, BOD and Temperature) and biological (Population of Coliforms including *E.coli*, Lactobacillus population, Yeast population and Actinomyces population) parameters of leachate from each sample are examined at an interval of 7 days. There was a generation of alcohol and vinegar like smell in the due process other than non offensive smell. Chemical parameters such as pH, TDS (Total Dissolved Solids) and BOD shows a declining trend. An increase in Salinity, conductivity and Dissolved Oxygen (DO) was also observed. While analysing the biological parameters a steady decrease in Non EM organisms are seen. Lactobacillus, Actinomyces and yeast populations almost doubled within 14 days compared to control. It can be concluded that jaggery is the best activator of Maple EM-compost a method of waste disposal at a low cost.

KEYWORDS:

Effective microorganisms, pH, counductivity, E.coli, jaggery.

1.INTRODUCTION

In India there are two major resources which play a vital role for country's development, they are human resource and agriculture. Unfortunately these two resources are the main source for the pollution in our country. 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 (Odum, 1977). Due to population growth, industrialization, urbanization and economic growth, a trend of significant increase in municipal solid wastage (MSW) generation has been recorded worldwide. MSW generation, in terms of kg/capita/day, has shown a positive correlation with economic development at world scale. Due to rapid industrial growth and migration of people from villages to cities, the urban population is increasing rapidly.Waste generation has been observed to increase annually in proportion to the rise in population and urbanization.

2. PROCEDURE

NEEDS OF SOLID WASTE MANAGEMENT

Disposal of solid waste is a major problem in the urban areas of the country. About 20- 40% of the waste generated remains uncollected on the Streets and neighbourhoods. Wastes are often dumped on open land areas and dumping of wastes causes unsanitary conditions, obnoxious odours and serves as a breeding ground for many diseases. Today we are facing difficulty in collection, treatment and disposal of ever-increasing quantity of both solid and liquid wastes. No doubt these wastes also affect public health, overall and local environment. It is estimated that in India the generation of solid wastes in urban areas is about 27.4 million tones every year.

EFFECTIVE MICROORAGANISM

Effective Microoraganism (EM) used in this study was supplied by Consolidated Agri Tech CO. (Calicut) as Maple EM 1 (Environment – Solid waste Management). EM solution is a brownish liquid with a pleasant odour and sweet sour taste with a pH of 3 and stored in cool place without refrigeration before activation.

Activating the Effective Microorganisms

EM is available in a dormant state and requires activation before application. Activation involves either the use of jaggery or rice water. Here, both jaggery and rice water is being used to activate expired and non-expired EM in order to take a comparison among them.

MUNICIPALITY SOLID WASTE AS A RESOURCE

Management of solid waste reduces or eliminates adverse impacts on the environment and human health and supports economic development and improved quality of life. Numbers of processes are involved in effectively managing wastage for a municipality. These include monitoring, collection, transport, processing, recycling and disposal. As per the characteristics municipality solid waste contains more than a 50 % biodegradable waste. Effective utilization of the solid waste surely will fulfill the fertilizer need of our country.

Technology Options

The MSW contains organic as well as inorganic matter. The latent energy of its organic fraction can be recovered for gainful utilization through the adoption of suitable waste processing and treatment technologies.

CHEMICAL CHARACTERISTICS OF WASTE

The Chemical characteristics of waste could be divided into three components; chemical, biochemical, and toxic. Sometimes, waste may have the presence of fat content (lipid) Chemical: It includes the N-P-K (nitrogen- phosphorous-potassium) pH, total carbon, C/N ratio and calorific value.

- Bio-chemical: It includes carbohydrates, proteins, natural fiber, and biodegradable factor.
- Toxic: Toxicity characteristics include heavy metals, pesticides, insecticides, and toxicity test for leachates.

FUNCTIONAL ELEMENTS OF MUNICIPAL SOLID WASTE MANAGEMENT

- Waste handling, sorting, storage, and processing at the source are the activities involved till the waste is placed in a container for collection. On-site storage is of primary importance because of the public health concern and aesthetic considerations.
- Collection includes not only the gathering of solid waste and recyclable material, but also its transportation to the processing/disposal site.
- Sorting, processing, and transformation of solid waste includes separation of bulky items, separation according to size by using screens, manual separation, and separation of ferrous and non-ferrous metals. Waste transformation is undertaken to reduce the volume, weight, and

size or the toxicity of waste without the resource recovery.

- Transfer and transportation entail two steps: transfer of waste from a smaller collection vehicle to a larger vehicle and subsequently, transportation over long distances to a processing or disposal site.
- Disposal in the landfills or uncontrolled dumping is the practice followed by most municipal bodies. A well-managed landfill is an engineered facility used for the disposal of solid waste. Tremendous increase in the solid waste generation will have a significant impact, in terms of the land area required for disposing waste as well as impact on the CH_4 (methane) emission.

SELECTION OF AREA

The area required for the decomposing of the municipal solid waste is selected. Two work space is been chosen for the aerobic decomposition and the anaerobic decomposition.

PREPARATION OF EFFECTIVE MICROORGANISMS

The EMS contains different strains of bacterial and fungal species.

The Bacterial species are:

1.Lactobacillus plantarum,

2.L.casei,

3.Rhodopseudomonas palustrus,

4.Cellulomonas fimi,

After the preparation of mother culture, important nutrients should be provided for the growth of the 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.

COLLECTION OF WASTE

One week gent's hostel mess waste 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.

SPRAYING OF EFFECTIVE MICROBIAL SOLUTION

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.

PROCESS AFTER DECOMPOSITION

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.

Then the sieved sample is tested for the following compounds:

a. pH
b. electrical conducitvity
c. nitrogen
d. potassium
e. phosphorous
f. organic carbon

3.LABORATORY ANALYSIS

3.1.ESTIMATION OF pH

A pH meter is an electronic device used for measuring the pH (acidity or alkalinity) of a liquid (though special probes are sometimes used to measure the pH of semi-solid substances).

The pH value of, Sample A (conventional) = 7.49

The pH value of sample B (anaerobic) = 7.12

The pH value of sample C (aerobic) = 7.34

3.2.ESTIMATION OF ELECTRICAL CONDUCTIVITY

The EC value of sample A (conventional) = 2.34
The EC value of sample B (anaerobic) = 4.36
The EC value of sample C (aerobic) = 4.12

3.3.ESTIMATION OF NITROGEN CALCULATION PROCEDURE

To get plant TKN %, N %,
= reading (mg/l) x 50 / 0.150 / 10000
The nitrogen value of sample A (conventional) = 0.73%
The nitrogen value of sample B (anaerobic) = 0.23%
The nitrogen value of sample C (aerobic) = 1.06%

3.4.ESTIMATION OF POTASSIUM

K % in plant
= ppm in reading x 10 x 50 / 0.500 / 10000
The potassium value of sample A (conventional) = 0.47%
The potassium value of sample B (anaerobic) =0.78%
The potassium value of Sample C (aerobic) =0.52%

3.5.ESTIMATION OF PHOSPHOROUS

To get plant TKN %, N %
= reading (mg/l) x 50 / 0.150 / 10000
The phosphorous value of Sample A (conventional) = 0.42%
The phosphorous value of Sample B (anaerobic) = 0.61%
The phosphorous value of sample C (aerobic) = 0.57%
The organic carbon value of sample A (conventional) = 9.36%
The organic carbon value of sample B (anaerobic) = 13.25%
The organic carbon value of sample C (aerobic) = 11.27%

4.RESULTS

4.1.pH

pH value of the conventional method, aerobic method and anaerobic method were 7.47,7.12 and 6.45 respectively.

4.2.ELECTRICAL CONDUCTIVITY (EC)

The electrical conductivity of the conventional method was 1.94 dSm-1, aerobic method was 1.12 dSm-1 and anaerobic method was 1.45 dSm-1.

4.3.ORGANIC CARBON (%)

The organic carbon of the conventional method, aerobic method and anaerobic method were 14.20, 11.28 and 10.45respectively.

4.4.NITROGEN (%)

The nitrogen content of the conventional method was 0.72, aerobic method was 0.95 and anaerobic method was 0.85.

4.5.PHOSPHORUS (%)

The Phosphorus content of the conventional method was 0.28, aerobic method was 0.47 and anaerobic method was 0.37

4.6.POTASSIUM (%)

The Potassium of the conventional method aerobic method and anaerobic method were 0.35, 0.41 and 0.46 respectively.

5.COMPARATIVE STUDY OF CONVENTIONAL, AEROBIC AND ANAEROBIC DECOMPOSITION

S.NO	PARAMETERS	CONVENTIONAL METHOD	AEROBIC METHOD	ANAEROBIC METHOD
1	pH	7.47	7.12	6.45
2	EC (dsm^{-1})	1.94	1.12	1.41
3	ORGANIC CARBON%	14.20	11.28	10.45
4	NITROGEN%	0.72	0.95	0.83
5	PHOSPHORUS%	0.28	0.47	0.37
6	POTASSIUM %	0.35	0.41	0.46

Table 1 Comparative Study of Conventional, Aerobic and Anaerobic Decomposition

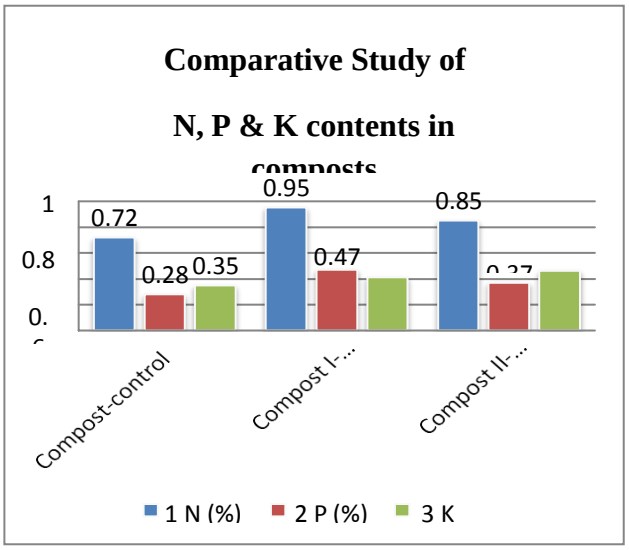

Figure 1 Comparative study of N,P&K contents in composts

6. 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 non pathogenic, 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 has 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.

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