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ELECTRIC POTENTIAL FROM VERMICOMPOSTING OF AGRICULTURAL WASTE USING EXOTIC EARTHWORM EUDRILUS EUGENIAE

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ABSTRACT

Vermicomposting is a very effective, eco-friendly, cheap and easy method of recycling biodegradable waste using selected species of earthworms. Vermicompost is also rich in metal ions, acids and salts that has the potential to be used as an electrolyte. The main aim of this investigation is to exploit the potential lying in earthworm species to convert agricultural waste into high quality vermicompost that can be used as an electrolyte to generate electric current. The spent tea waste was vermicomposted for 60 days using Eudrilus eugeniae. An effective voltage was measured between copper and zinc electrodes immersed in vermicompost (electrolyte). The voltage was doubled when three isolated vermicompost cells were connected in series and could light up an LED bulb. The total macronutrients (N, P, K and Ca) and micronutrients (Fe, Cu, Mn and Zn) showed elevated levels in vermicompost when compared to control which contributed to the chemical reaction at the electrodes to create a potential difference across the electrodes thus giving a voltage. The present study reveals that the vermicomposting has a great future in generation of electrical energy from biodegradable waste.

KEYWORDS Vermicompost, Micro and Macronutrients, Electric potential, agricultural waste, *Eudrilus eugeniae.*

CHAPTER 1: Introduction

The various types of environmental and disposal problems caused by the production of large quantities of agricultural waste all over the world requires sustainable approach in a cost effective manner and this has become a very important issue for maintaining healthy environment.Due to the rapid growth in industrialization, the most of the rural population have shifted towards the urban area in search of employment. India produces 1,20,000 tonnes of agricultural wastes every day. The rapid increase in the volume of waste is one aspect of the environmental crisis, accompanying global development. Most common practices of waste processing are uncontrolled dumping. When waste is dumped into large heaps, air cannot get to the organic waste that is degrading.This creates a harmful greenhouse gas, methane which damages Earth's atmosphere. The agricultural waste is a by-product from rice straw and other waste after decaffeination process which waste that can be used in various ways. Apart from losing the economic value of the waste, a huge amount of capital is expended in disposing it. Some places, the waste constitutes environmental hazards through indiscriminate dumping and incineration.Vermicomposting is a very useful biotechnique for converting waste into vermicompost. The vermicomposting provides for the use of earthworms as natural bioreactors for cost-effective and eco friendly waste management. Earthworm has the efficiency to consume all types of organic rich waste material including tea waste, vegetable wastes, leaf litter waste, industrial, dairy farm wastes, garden waste, sugar mill residues, slaughter house waste, hatchery waste and municipal wastes. The ability of the exotic composting species, Eudrilus eugeniae to transform the agricultural waste into valuable compost is considerable. Other than being an fertilizer, this secreted chemical mixture which is rich in metal ions, acids, salts and enzymes have the potential to be used as an electrolyte. Vermicompost being harmless do not cause any environmental pollution like the chemical electrolytes used in battery. The ions present in the vermicompost can react with the metal electrodes used in the cell and can produce a potential difference across the electrodes. This potential difference can generate enough voltage similar to that produced by a commercial battery cell. The waste to energy can be considered as a renewable technology and a better solution to waste management. Even though food, plant and animal waste have been used as alternative resources for electricity generation, they have several drawbacks. Conventional composting and anaerobic digestion produces foul smell and harmful methane gas. According to the considerations of low cost, eco-friendly, fast and efficient, we choose to explore the suitability of vermicompost from agricultural waste an alternative to replace chemical electrolytes.

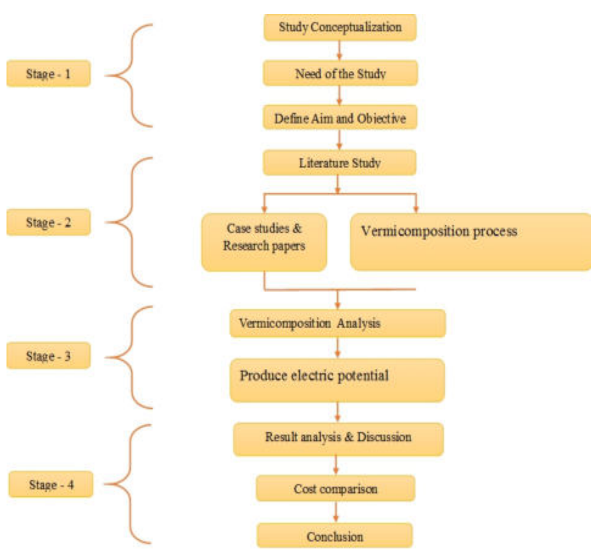
Problem statement: The problem of efficient disposal and management of organic solid wastes has become more rigorous due to rapidly increasing population, intensive agriculture and industrialization, over the last few years. The various types of environmental and disposal problems caused by the production of large quantities of organic waste all over the world requires sustainable approach in a cost effective manner and this has become a very important issue for maintaining healthy environment.

1.2Aim:

TO STUDY ABOUT "ELECTRIC POTENTIAL FROM VERMICOMPOSTING OF AGRICULTURAL WASTE USING EXOTIC EARTHWORM EUDRILUS EGUENIAE"

1.3 OBJECTIVE:

1) Detail study and analysis of the vermicomposting waste.
2) To maintain 70% moisture and pH 6.9.
3) To use agricultural waste from vermicomposting as fertilizer.
4) Anode (copper) and cathode (zinc) plate used to generate electricity. Anode and cathode plate size is18 gauge.
5) To measure voltage in vermicomposting waste



1.5 SCOPE OF STUDY

- To produce electricity and great amount of fertilizer component.
- To find electric potential.
- To find pH,
- Moisture, Voltage, Nitrogen, Calcium, phosphorous

1.6 LIMITATION OF STUDY
In this fertilizer rich in metal ions, acids and salts that has the potential to be used as an electrolyte. The main aim of this investigation is to exploit the potential lying in earthworm species to convert spent tea waste into high quality vermicompost that can be used as an electrolyte to generate electric current.

1.7 NEED OF STUDY
- Day by Day in India to produce approximately 1,20,000 tons agricultural waste is generated.
- The electric potential produces high so huge amount of electricity produce
- This vermicomposting waste uses as fertilizer
- High amount in macro nutrient like calcium, phosphorous and nitrogen.

1.8Work Plan

Stage	Month								
	Sept	Oct	Nov	Dec	Jan	Feb	March	April	May
Study Conceptulation									
Literature Review									
Characterize Waste									
Developing Lab Scale Model									
Sample Analysis									
Data Interpretation and Tabulation									
Conclusion And Recommendation									
Development And Final Thesis Report									

CHAPTER 2. LITERATURE REVIEW
Literature was assorted and compiled through sources like libraries, journals and various online search engine. The literature survey covers the topics listed below related to the topic of the study including some papers.
- vermicomposting Introduction.
- Source and Types of vermicomposting.
- Principles of vermicompostion of electrolysis process.
- Life Cycle Assessment of worms
- Applicability criteria of vermicomposting in agricultural and other site.
- worms use decomposition of physio chemical process
- Strategy to use different waste
- Research papers related to study.

Paper no.	Study topic	Author	journal	finding
1	Electric Potential from Vermicomposting of Spent Tea waste by employing Exotic Earthworm Eudrilus Eugenia	Evelyn Pigares and M Lakshmi Prabha	International Journal of ChemTech Research ISSN : 0974-4290 Vol.6, No.2, pp 1022-1027, April-June 2014	In this process produce 1.15V and use copper and zinc plate as anode and cathode To use tea waste and measured calcium phosphorous and potassium
2	Electricity Potential from Vermicompost (Waste to Energy)	R. A. Karim, N. M. A. Ghani	International Journal Vol:5, No:10, 2011	To use copper and zinc plate as anode and cathode To use tea waste and produce 1.50V In tea waste to find calcium, magnesium and macronutrient,conductivity,salinity and ph
3	Potential of vermicompost produced from plant waste on the growth and nutrient status in vegetable production	J.Theunissen, P. A. Ndakidemi	International Journal of the Physical Sciences Vol. 5(13), pp. 1964-1973, 18 October, 2010 ISSN 1992 - 1950 ©2010	To use Eisenia fetida earthworm and using plant waste from vermicomposting To find calcium phosphorous and nitrogen and pH ,moisture.
4	The Potential of Natural Waste (Corn Husk) for Production of Environmental Friendly Biodegradable Film for Seedling.	M.Z. Norashikin and M.Z. Ibrahim (2009)	International Journal of Agriculture Innovations and Research Volume 2, Issue 1, ISSN august 2009	To use Natural waste and composting period 270 days. To find pH and moisture and calcium ,nitrogen To use copper and zinc plate as anode and cathode
5	Potentiality of Earthworms for Waste Management	Satyawati Sharma, Kaviraj Pradha (2005)	The Journal of American Science, 1(1), 2005, Sharma, et al, Potentiality of Earthworms for Waste Management	To use estedia fedia earthworm and use organic waste like cow dung To find calcium, phosphorous, moisture and pH in organic waste
6	Electric signals for separation of *earthworms Eudrilus eugeniæ*	Maria J. de Moraes1, Delly Oliveira Filho2,	International Journal of Agriculture Innovations and Research v.16, n.10, p.1137–1142, 2012	To use eudrilus euganiae earthworm and use natural waste To find calcium and magnesium in natural waste and find moisture and pH
7	A potential bioconversion of empty fruit bunches into organic fertilizer using Eudrilus eugeniae	P. N. Lim • T. Y. Wu • C.Clarke	Int. J. Environ. Sci. Technol. (2015) ISSN:2533–2544	To find calcium and other micro nutrient vermicomposition time period is 12 weeks To use copper and zinc plate as anode and cathode
8	Potential of earthworm meal as a replacement of fish meal for Indian major carps	MM Beg, B Mandal, S Moulick	International Journal of Fisheries and Aquatic Studies 2016; 4(3): 357-361 ISSN: 2347-5129	To find protein and vitamin in this waste Replacement as fish meal as earthworm and good amount of protein source
9	Potential of mealworm *(Tenebrio molitor) as an alternative protein* source in practical diets for	Ng WK, Liew FL, Ang LP, Wong KW	International Journal of Fisheries and Aquatic Studies 2016; Res. 2001; 32:273-280.	To find protein and vitamin in this waste Replacement as fish meal as earthworm and good amount of protein source

	African catfish, Clarias gariepinus. Aquac.			
10	Electric potential from Bioconversion of garden waste, kitchen waste and cow dung into value-added products using earthworm *Eisenia fetida*	K.A. Wani , Mamta , R.J. Rao	International Journal *of Biological Sciences 20*, ISSN 149–154.	To find potential in bioconversion waste To use eisenia fedia earthworm and 60 days composition period To use copper and zinc plate as anode and cathode
11	Vermicomposting of coffee pulp using the earthworm *Eisenia fetida: effects on C and N* contents and the availability of nutrients	F. H. Orozco, J. Cegarra, L. M. Trujillo	International Journal *of Biological Sciences 20,* ISSN 874–159.	To find potential in coffee and pulp waste To use eisenia fedia earthworm and 65 days composition period and carbon and nitrogen ratio maintain.
12	Electric potential from organic fertilizer using *Eisenia fetida*	P.B.Londhe S.M.Bhosale	INTERNATIONAL JOURNAL OF INNOVATIONS IN ENGINEERING RESEARCH AND TECHNOLOGY [IJIERT] ISSN: 2394-3696 VOLUME 2, ISSUE 6, JUNE-2015	In 45 days composition period and specific interval to measure ph and moisture To use eisenia fetida earthworm
13	AGROINDUSTRIAL WASTES FOR VERMICULTURE AND VERMICOMPOSTING using earthworm	M.A.Soniya and S.Dhanasekaran	INTERNATIONAL JOURNAL OF MODERN RESEARCH AND REVIEWS Volume 3, Issue 5, pp 663-668, May, 2015 ISSN: 2347-8314	In 65 days composition period and specific interval to measure calcium and nitrogen To use agro industrial waste To use estedia earthworm in agro waste
14	Potential of Eisenia fetida for sustainable and efficient vermicomposting of fly ash	S.K., A.Tewari, R.Srivastava,R.C.Murthy and S.Chandra	INTERNATIONAL JOURNAL AMERICAN ISSN: 293-302	To measure the voltage in organic waste vermicompositing period 120 days in organic waste In organic waste to find calcium, potassium.

Method:

Firstly collect the waste from different source like market and other site. waste is collected in container. when the waste will decomposed then still the worms. when degradation process 2-3 time sprinkle water to vermicompost technique. The hour period for ready fertilizer is 40 – 30 days. Two electrodes will be connect with circuit because of electrolysis process electricity will be generate. Voltage will be measured by voltmeter. This electricity use for domestic purpose.

Collection of Waste

The spent different waste was collected from home. The collected wastes were dried and used for vermicomposting.

Collection of Earthworm

The exotic earthworms Eudrilus eugeniae were collected from Agricultural university ,NAVSARI and cultured in laboratory conditions for proper growth and survival of earthworms.

Vermicomposting technique

Clay pots were used as containers for vermicomposting as it can maintain moisture and low temperature required for the worms to grow. Totally 3 pots were maintained for the experimental purposes. The pot T1 was taken for vermicomposting of spent tea (with earthworms). T2 was maintained as control for spent tea waste. T3 was control for soil with earthworms .In pot T1 500g of spent tea waste was taken and mixed with proper amount of soil to neutralize the pH of tea waste. The earthworm Eudrilus eugeniae was released into the pots T1 and T3 at the rate of 60 worms per square feet except control. Care was taken to avoid light and rainfall. Samples were taken from the control as well as the experimental pots on 60th day for the analysis of macro and micro nutrients, physicochemical analysis and electric potential.

NUTRIENT CONTENT:

MACRONUTRIENTS

Estimation of total nitrogen

The nitrogen in organic material is converted to ammonium sulphate by sulphuric acid during digestion. This salt, on steam-distillation, liberates ammonia which is collected in boric acid solution and titrated against
standard acid.

Estimation of total phosphorus

Inorganic phosphate reacts with ammonium molybdate in an acid solution to form phosphomolybdic acid. Addition of a reducing agent reduces the molybdenum in the phosphomolybdate to give a blue colour, butdoes not affect the uncombined molybdic acid. The blue colour produced is proportional to the amount of phosphorus present in the samples.

Estimation of total potassium

In flame photometry, the solution under test is passed under carefully controlled conditions as a very fine spray in the air supply to a burner. In the flame, the solution evaporates and the salt dissociates to given neutral atoms. A very small proportion of this move into a higher energy state. When these excited atoms fall back to the ground state, the light emitted is of characteristic wavelength which is measured.

Estimation of total calcium

The pH of the sample is made sufficiently high to precipitate magnesium as hydroxide, and calcium only is allowed to react with EDTA in the presence of a selective indicator.

ESTIMATION OF PHYSICOCHEMICAL PARAMETERS

pH

5gm of finely powdered vermicompost was taken in a volumetric beaker and 50ml of distilled water was added and the pH was measured by pH meter.

Moisture

The moisture content was then calculated as follows:
P = Weight of the empty plate
PW = Weight of the plate with wet sample
PD = Weight of the plate with the dry sample

Percentage of moisture content=[(PW-PD)/(PD-PW)+(PW-PD)]*100

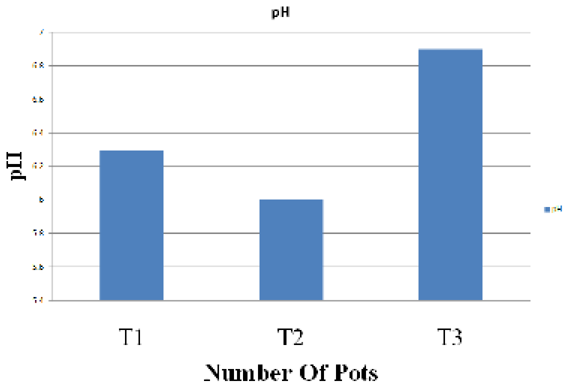
ESTIMATION OF ELECTRIC POTENTIAL

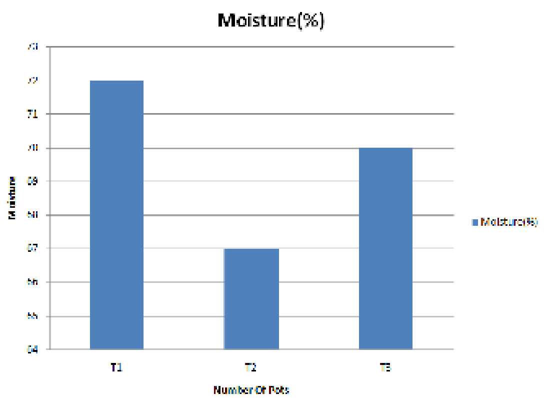
Electrode was used as an electrical conductor to touch base with a non-metallic part of a circuit.

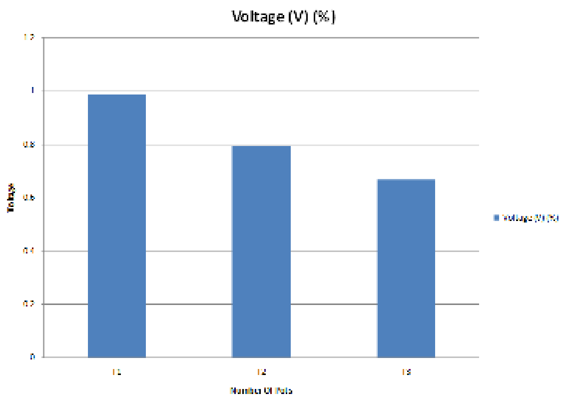
Electrode was referred as either anode or cathode. Determination of anode or cathode was depending on thedirection of current through the cell. Determination of electrodes was based on the metal elements in periodic table. Two different metals, copper and zinc plates were used as electrodes and vermicompost as electrolyte.

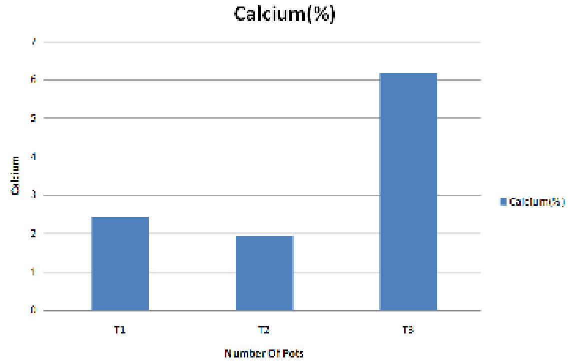
The electrode plates were polished using sand papers to remove oxides formed due to oxidation of metals. The copper plate acts as cathode and zinc plate acts as anode. The anode and cathode were then immersed into the vermicompost that is moistened to enhance the contact with the metal plates. The lead wires were connected to the electrodes, multimeter and LED in series circuit. Multimeter is used to measure the voltage between two electrodes.

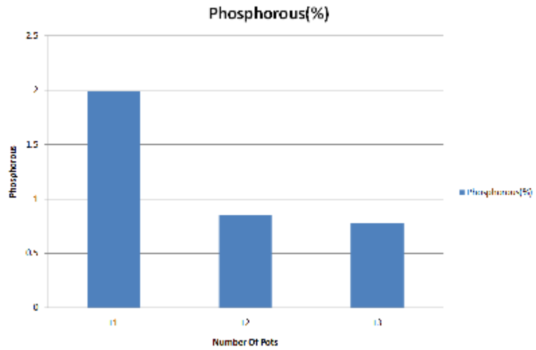
Sample	pH value	Moisture(%)	Voltage (V)(%)	Calcium(%)	Phosphorous (%)	Potassium(%)	Nitrogen (%)	Temp (oC)
Vermicompost(T_1)	6.3	72	0.988	2.44	1.99	0.58	2.02	30
agricultural waste(T_2)	6.0	67	0.794	1.93	0.85	0.29	0.98	29
Soil sample with worms (T_3)	6.9	70	0.670	6.18	0.78	9.46	2.26	30

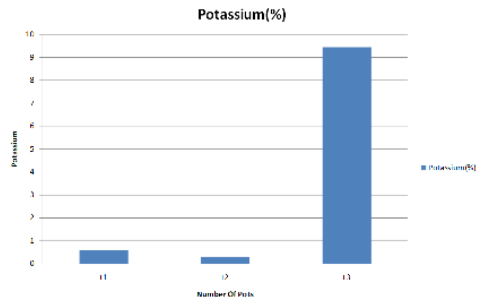


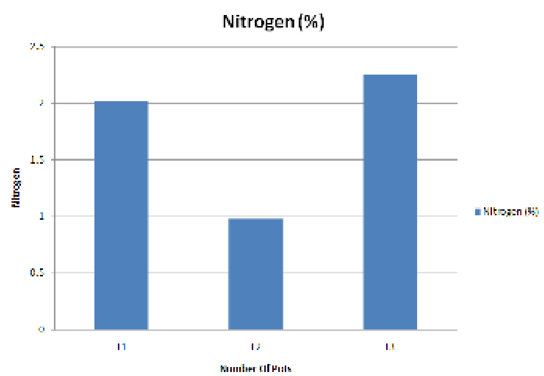


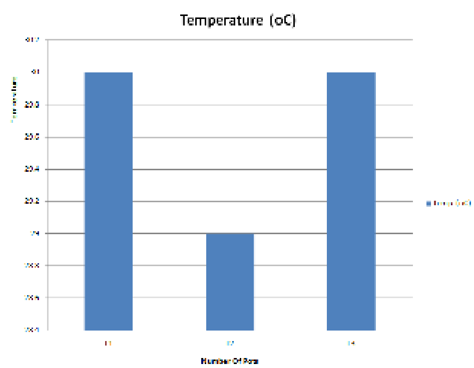












CHAPTER -2:
2.1 VERMICOMPOSTING

- Vermicomposting is the process by which worms are used to convert organic materials into a humus-like material known as vermicompost. The goal is to process the material as quickly and efficiently as possible.
- These two processes are similar but different. If your goal is to produce vermicompost, you will want to have your maximum worm population density all of the time. If your goal is to produce worms, you will want to keep the population density low enough that reproductive rates are optimized.
- Both of these processes will be described in some detail in this manual.

Fig.2.1 VERMICOMPOSTING PLANT

2.2 TYPES OF VERMICOMPOSTING SYSTEMS

- There are three basic types of vermicomposting systems of interest to farmers: windrows, beds or bins, and flow-through reactors. Each type has a number of variants. Windrows and bins can be batch or continuous-flow systems, while all flow-through systems, as the name suggests, are of the continuous-flow variety.

2.2.1 Windrows
Windrow vermicomposting can be carried out in a number of different ways. The three most common are described here.

1] Static pile windrows (batch)
Static pile windrows are simply piles of mixed bedding and feed (or bedding with feed layered on top) that are inoculated with worms and allowed to stand until the processing is complete. These piles are usually elongated in a windrow style but can also be squares, rectangles, or any other shape that makes sense for the person building them. They should not exceed one meter in height (before settling). Care must be taken to provide a good environment for the worms, so the selection of bedding type and amount is important (see Section 2.1.2). In the OACC vermicomposting trials (see Appendix D), the original selection of aged dairy manure as bedding turned out to be a poor choice, and initial worm reproduction was quite slow. After the bedding was supplemented with large quantities of hay and silage, increasing the porosity of the windrows, worm reproduction took off.

2] Top-fed windrows (continuous flow)
Top-fed windrows are similar to the windrows described above, except that they are not mixed and placed as a batch, but are set up as a continuous-flow operation. This means that the bedding is placed first, then inoculated with worms, and then covered repeatedly with thin (less than 10 cm) layers of food. The worms tend to consume the food at the food/bedding interface, and then drop their castings near the bottom of the windrow.

A layered windrow is created over time, with the finished product on the bottom, partially consumed bedding in the middle, and the fresher food on top. Layers of new bedding should be added periodically to replace the bedding material gradually consumed by the worms.

3] Wedges (continuous Slow)
The vermicomposting wedge is an interesting variation on the top-fed windrow. An initial stock of worms in bedding is placed inside a corral-type structure (3-sided) 15 of no more than three feet or one meter in height. The sides of the corral can be concrete, wood, or even bales of hay or straw. Fresh material is added on a regular feeding schedule through the open side, usually by bucket loader. The worms follow the fresh food over time, leaving the processed material behind. When the material has reached the open end of the corral, the finished material is harvested by removing the back of the corral and scooping the material out with a loader. A 4th side is then put in place and the direction is reversed. Using this system, the worms do not need to be separated from the vermicompost and the process can be continued indefinitely. During the coldest months, a layer of insulating hay or straw can be placed over the active part of the wedges.

2.2.2 Beds or Bins
1] Top-fed beds (continuous flow)
A top-fed bed works like a top-fed windrow. The main difference is that the bed, unlike a windrow, is contained within four walls and (usually) a floor, and is protected to some degree from the elements, often within an unheated building such as a barn. The beds can be built with insulated sides, or bales of straw can be used to insulate them in the winter. If the bins are fairly large, they are sheltered from the wind and precipitation, and the feedstock is reasonably high in nitrogen, the only insulation required may be an insulating "pillow" or layer on top. These can be as simple as bags or bales of straw.

2] Stacked bins (batch or continuous flow)
One of the major disadvantages of the bed or bin system is the amount of surface area required. While this is also true of the windrow and wedge systems, they are outdoors, where space is not as expensive as it is under cover. Growing worms indoors or even within an unheated shelter is an expensive proposition if nothing is done to address this issue. Stacked bins address the issue of space by adding the vertical dimension to vermicomposting. The bins must be small enough to be lifted, either by hand or with a forklift, when they are full of wet material. They can be fed continuously, but this involves handling them on a regular basis (Beetz, 1999). The more economical route to take is to use a batch process, where the material is pre-mixed and placed in the bin, worms are added, and the bin is stacked for a pre-determined length of time and then emptied. This method is used by a number of professional vermicompost producers in North America.

2.2.3 Flow-Through Reactors
The flow-through concept was developed by Dr. Clive Edwards and colleagues in England in the 1980s. It has since been adopted and modified by several companies, including Oregon Soil Corporation of Portland, Oregon, and the Pacific Garden Company, based in Washington and Pennsylvania. The system operates as follows. The worms live in a raised box, usually rectangular and not more than three meters in width. Material is added to the top, and product is removed through a grid at the bottom, usually by means of a hydraulically driven breaker bar. The term "flow-through" refers to the fact that the worms are never disturbed in their beds – the material goes in the top, flows through the reactor (and the worms' guts), and comes out the bottom .The method for pushing the materials out the bottom is usually a set of hydraulically powered "breaker bars" that move along the bottom grate, loosening the material so that it falls through. Clive Edwards has stated that "properly managed" flow-through unit of approximately 1000 ft2 surface area can process 2 to 3 tonnes per day of organic waste

CHAPTER -3:WORMS
3.1 THE WORM
There are an estimated 1800 species of earthworm worldwide. This project is only focused on Eisenia fetida. Eisenia fetida is commonly known as : the "compost worm", "manure worm", "redworm", and "red wiggler".

Fig.3.1 Worms

3.2 THREE TYPES OF EARTHWORM

1] Anecic ("out of the earth") – these are burrowing worms that come to the surface at night to drag food down into their permanent burrows deep within the mineral layers of the soil. Example: the Canadian Night crawler.

2] Endogeic ("within the earth") – these are also burrowing worms but their burrows are typically more shallow and they feed on the organic matter already in the soil, so they come to the surface only rarely.

3] Epigeic ("upon the earth") – these worms live in the surface litter and feed on decaying organic matter. They do not have permanent burrows. These "decomposers" are the type of worm used in vermicomposting.

Species of earthworms

There are about 3000 species of earthworms distributed all over world and about 384 species are reported in India (Julka, 1986). Most earthworms are terrestrial organisms, which live in the soil. But some species like Pontodrilus burmudensis lead a comfortable life in estuarine water. Taxonomic studies on the Indian earthworms species have been carried out mainly by Julka (1983).

Earthworms vary greatly in size, In India some peregrine species like Microscotex phosphoreus (Duges) are even 20 mm long while some endemic geophagous worms such as Drawida grandus (Bourus) may reach up to one meter in length.

Earthworm occur in diverse habitats, organic materials like manures litter, compost etc are highly attractive for earthworms but they are also found in very hydrophilic environment close to both fresh and brachish water, some species can survive under snow. Most of the earthworms are omnivorous, however Agastrodrilus, a carnivorous genus of earthworms from the Ivory Coast of Africa has been reported to feed upon other earthworms of the family Eudrilidae (Levelle, 1983).

3.3 WORMS NEED

1] A food source
2] Adequate moisture (greater than 50% water content by weight)
3] Adequate aeration
4] Protection from temperature extremes
5] A hospitable living environment

3.3.1 A food source

- Compost worms are big eaters. Under ideal conditions, they are able to consume in excess of their body weight each day, although the general rule-of-thumb is ½ of their body weight per day5. They will eat almost anything organic (that is, of plant or animal origin,waste), but they definitely prefer some foods to others.

3.3.2 Adequate Moisture

- The need for adequate moisture was discussed in relation to bedding . The bedding used must be able to hold sufficient moisture if the worms are to have a livable environment. They breathe through their skins and moisture content in the bedding of less than 50% is dangerous. With the exception of extreme heat or cold, nothing will kill worms faster than a lack of adequate moisture.
- The ideal moisture-content range for materials in conventional composting systems is 45-60% (Rink et al, 1992). In contrast, the ideal moisture-content range for vermicomposting or vermiculture processes is 70-90.

3.3.3 Adequate Aeration

- Worms are oxygen breathers and cannot survive anaerobic conditions (defined as the absence of oxygen). When factors such as high levels of grease in the feedstock or excessive moisture combined with poor aeration conspire to cut off oxygen supplies, areas of the worm bed, or even the entire system, can become anaerobic.

3.3.4 Protection from temperature extremes

- Controlling temperature to within the worms' tolerance is vital to both vermicomposting and vermiculture processes. This does not mean, however, that heated buildings or cooling systems are required.

3.3.5An hospitable living environment

(1) High absorbency.

Worms breat he through their skins and therefore must have a moist environment in which to live. If a worm's skin dries out, it dies. The bedding must be able to absorb and retain water fairly well if the worms are to thrive.

(2)Good bulking potential.

If the material is too dense to begin with, or packs too tightly, then the flow of air is reduced or eliminated. Worms require oxygen to live, just as we do. Different materials affect the overall porosity of the bedding through a variety of factors, including the range of particle size and shape, the texture, and the strength and rigidity of its structure. The overall effect is referred to in this document as the material's bulking potential

Characteristics of vermicompost

Vermicompost, a product of a non- thermophilic biodegradation of organic material through interactions between earthworms and micro organisms, is a peat like material with high porosity, aeration, drainage, water holding capacity and microbial activity, (Edwards, 1998; Atiyeh, 2000d). It contains most nutrients in plant available forms such as nitrates, phosphates, exchangeable calcium, soluble potassium etc (Edward, 1998) and has large particular surface area that provides many microsites for microbial activity and for the strong retention of nutrients. The plant growth regulators and other plant growth influencing materials i.e. auxins, cytokinins, humic substances etc, produced by micro organisms have been reported from vermicompost (Atiyeh, 2002b; Muscolo, 1999). The humic materials extracted from vermicomposts have been reported to produce auxin- like cell growth and nitrate metabolism of carrots (Daucus carota) (Muscolo, 1999). However humic substances can occur naturally in mature animal manure, sewage sludge or paper – mill sludge but their amount and rates of production are increased dramatically by vermicomposting. The nutrient status of vermicompost produced with different organic waste is; organic carbon 9.15 to 17.98 %, total nitrogen 0.5 to 1.5 %, available phosphorus 0.1 to 0.3 %, available potassium 0.15, calcium and magnesium22.70 to 70 mg/100g, copper 2 to 9.3 ppm, Zinc 5.7 to 11.5 ppm and available sulphur, 128 to 548 ppm (Kale, 1995). Several researchers have compared vermicasts with the surrounding soils and reported their results (Lavelle, 1978). The vermicasts have been reported with a higher Base Exchange capacity and are rich in total organic matter, phosphorus potassium and calcium with a reduced electrical conductivity, large increase in oxidation potential and significant reductions in water-soluble chemicals which constitute possible environmental contaminants. Humic acid like components (HAL) were isolated by conventional procedures from various organic wastes including animal manures, a municipal solid refuse and a sewage sludge that were composted for 2-3 months with the earthworms E. fetida or Lumbricus rubellus by Senesi et al. (1992). Vermicompost HAL containing appreciable amounts of Fe and Cu in inner sphere complexes of definite chemical and geometrical forms, similar to those found in humid acid (HA) from soil and other sources, can be considered adequate analogues of soil HA with respect to their metal complexion properties and behavior. Vermicompost is rich in microbial diversity, population, and activity (Subler, 1998) and vermicast contains enzymes such as proteases, amylases, lipase, cellulase and chitinase which continue to disintegrate organic matter even after they have been ejected. The chemical analysis of casts shows 2 times the available magnesium, 5 times the available nitrogen, 7 times the available phosphorus and 11 times the available potassium compared to the surrounding soil (Bridgens, 1981). The vermicompost is considered an excellent product since it is homogenous, has reduced level of contaminants and tends to hold more nutrients over a longer period without impacting the environment (Ndegwa, 2001).

Waste stabilization by vermicomposting

Agricultural waste, horticultural waste, animal waste, silkworm litter, plant biomass (leaf litter), weeds, kitchen waste abiding, foul, acidic, spicy and spoilt food, city refuse after removing non-degradable waste material such as glass, plastic, strong rubber and metal can be vermicomposted (Kale, 1995). Vermicomposting of pre - treated pig manure using E. fetida produced a humus rich odour free vermicast (Chan, 1988). Pheretima asiatica could stabilize most of the solids arising from the treatment waste including raw pig manure (Wong, 1991). Dominguez at al. (1997) studied the total and available content of Zn and Cu during the vermicomposting process, because these are problematic minerals in pig manure. Although as a consequences of the carbon losses by mineralization during process the total amount of heavy metals increase (between 25-30%), the amounts of bioavailability heavy metals tend to decrease by 35 – 55 % in two months. Dominguez (1997) vermicomposted pig manure and observed 50-60 % higher nutrients in the earthworm treatments than in the control.

Earthworms

In the present studies the well known species of earthworm Eisenia fetida was obtained from a vermiculture & vermicomposting unit of Bareilly University, Bareilly, Uttar Pradesh, India. The stock culture of the earthworm was maintained in plastic containers using cowdung as growth medium in laboratory condition. This was further used in the vermicomposting experiment.

Preparation of Vermicomposting container

For vermicomposting plastic tubs of size 25 X 15 cm and of 2 kg capacity were used. The shade dried sugar-cane residues (B & PM) were then blended with organic growth promoter Jeevamrutham which is rich in microbes and used as a bulking agent to increase the C/N ratio of wastes. The mixture was prepared by mixing 1000 ml of Jeevamrutham, 1000 g sugarcane bagasse and 1000 g sugarcane pressmud (Moisture content of this admixture was determined by gravimetric method (APHA, 1985) and was adjusted to 80% by sprinkling water) and then this admixture was used for vermicomposting process.

As the vermicomposting progressed, pH tended towards neutral (8.37 to 7.13) and the decrease in pH was caused by the volatilization of ammonical nitrogen and H+ released due to microbial nitrification process by nitrifying microbes (Eklind and Kirchmann, 2000). Other researchers (Suthar and Singh, 2008) have shown higher reduction in pH in the vermireactors. The EC was reduced (1.02 to 0.87 %) and it may be due the loss of weight of organic matter and release of different mineral salts in available form. Some researchers have shown reduction in EC in verious vermireactor.

Total nitrogen content was increased (1.2 to 2.3 %) at the end of study. Earthworm activity enriches the nitrogen profile of vermicompost through microbial mediated nitrogen transformation, through addition of mucus and nitrogenous wastes secreted by earthworms.

Decrease in pH may be an important factor in nitrogen retention as N2 is lost as volatile ammonia at high pH values.

Potential applications of earthworms and vermicompost in plant growth vermicompost has been found an ideal organic manure enhancing biomass production of a number of crops (Vasudevan, 1997b; Hidalgo, 1999; Pashanasi, 1996). The importance of vermicompost in agriculture, horticulture, waste management and soil conservation has been reviewed by many workers (Edwards, 1995; Riggle, 1994, Kaviraj, 2003). Darwin (1881) stated that the earthworms prepare the ground in an excellent manner for the growth of fibrous-rooted plants and for seedlings of all kinds. The beneficial effect of earthworms on plant growth may be due to several reasons apart from the presence of macro nutrients and micronutrients in vermicasts and in their secretions in considerable quantities. It is believed that earthworm produce certain metabolites, vitamins and similar substances into the soil which may be the B or D group vitamins (Nielson, 1965). In addition to increased N availability, C, P, K, Ca and Mg availability in the casts is also greater than in the starting feed material (Orozco, 1996). Earthworm cast amendment has been shown to increase plant dry weight (Edwards, 1995) and plant N uptake (Tomati, 1994). Cantanazaro (1998) demonstrated the importance of the synchronization between nutrient release and plant uptake and showed that slower release fertilizers can increase plant yield and reduce nutrient leaching.

CHAPTER 4:ELECTROLYSIS

4.1 ELECTRODE

- An electrode is a conductor that passes an electrical current from one medium to another, usually from a power source to a device or material. It can take a number of different forms, including a wire, a plate, or a rod, and is most commonly made of metal, such as copper, silver, lead, or zinc, but can also be made of a non-metallic substance that conducts electricity, such as graphite. Electrodes are used in welding, electroplating, batteries, medicine, and in industry for processes involving electrolysis.

Earthworms are often preferred subject in soil ecotoxicological research because they are quite easy to handle and measure their different life cycle parameters, in accumulation and excretion of metals and biochemical responses. Earthworms ingest large amount of soil and are therefore exposed to heavy metals through their intestine as well as through the skin, wherefore concentrating heavy metals from the soil in their body (Morgan, 1999). Earthworms may serve as bioindicators of soil contaminated with pesticides i.e. polychlorinated biphenyls, polycyclic hydrocarbons (Saint-Denis, 1999), and heavy metals (Spurgeon, 1999a). Lead, cadmium, zinc and copper are accumulated and, under some environmental conditions, bioconcentrated in earthworms (Cortet, 1999). It is presumed that in many cases zinc is the critical toxic metal for these organisms (Spurgeon, 2000).

Suppression of labile aluminium in acidic soils by the use of vermicompost extract (VCE) was observed by chelation combined with pH induced precipitation. (Mitchell, 1993). The same authors in 1992 also reported that in solutions above pH 6, a 98% reduction of total Al was obtained due to pH effects, whereas at pH 4, a reduction of 90% was obtained due to chelation (Alter, 1992). Ireland (1977) reviewed the effect of various pesticides and heavy metals on earthworms. This will bring down the risk of entry of these pollutants into plant system and then into sequential food chain. When worms are used for this purpose, they should be prevented from entering into food chain as they are found to concentrate very high levels of these toxins in their tissue.

Other uses

Earthworms are known as a protein rich source of cattle feed. The dry matter of earthworms has been found to be around 20 to 25 percent of the fresh weight. This contains around 60 % protein, 7-10 % fat, 8-10 % ash, 0.55 % Ca and 1 % phosphorus. Eudrilus eugeniae has been successfully used for this purpose in India and abroad. Converting 1 tone of cattle dung into 450 kg of usable humus and 40 kg of earthworms, 6.5 kg of worm meal with 70% protein content for animal feed was produced (Hennuy, 1986). When vermicompost, produced with E. fetida, was given as feed for chick, it reduced caecal colonization by Salmonella tphimurium and S. enteritidis (Spencer, 1995). Earthworms' meal has been experimentally fed to pigs (Harwood, 1978), mice and rats (Schulz, 1977). According to Harwood (1976) chickens fed on earthworms meal had better feed conversion ratios. Earthworm can be used as bio-indicators for the monitoring of ecosystem state and changes. Various workers identified the earthworms for evaluating the effect of soil contamination with heavy metals and pesticides, agricultural practices, and acid rain etc. (Paoletti, 1991).

4.2 ANODES AND CATHODES

In the case of a direct (DC) current, electrodes come in pairs, and are known as anodes and cathodes. For a battery, or other DC source, the cathode is defined as the electrode from which the current leaves, and the anode as the point where it returns. For reasons that are historical rather than scientific, electricity in a circuit is, by convention, depicted as travelling from positive to negative, so that it is seen as a flow of positive charge out from the cathode, and into the anode. An electrical current, however, consists of a flow of tiny negatively charged particles called electrons, so this flow is actually in the opposite direction. In this context, it is probably better to think simply in terms of positive and negative terminals.

Inside a battery, or electrochemical cell, the electrodes are made of different materials, one of which gives up electrons more easily than the other. They are kept in contact with a conducting chemical that can split into positively and negatively charged ions. When a circuit is completed, in other words, when the battery is connected to an electrical device, such as a light bulb, a redox reaction takes place within the cell.

This means that the conducting chemical gains electrons at one electrode a process known as reduction and loses them at the other a process called oxidation with the result that the electrons flow as a current round the circuit. Reduction always takes place at the cathode, and oxidation at the anode.

In a rechargeable battery, this process is reversed while the battery is charging. An electrical current.

CHAPTER 5: PROCESS OF PROJECTPROCESS OF GENERATING ELECTRICITY FROM AGRICULTURAL WASTE

Firstly collect the waste from different sources like house, market or disposal side. Waste is collected in container. When the waste will decomposed then adds the worms. After the degradation process 2 -3 time sprinkler the water to vermicomposting container. The time period for ready fertilizer is 40-50 days.

Various technologies are available to generate electricity from fertilizer on a household's level.

Approximately 100g fertilizer takes in different pots. In this pot two electrodes will be connect with circuit. Because of this electrolysis process electricity will be generate. Voltage will be measure by voltmeter. This electricity is use for domestic purpose.

ADVANTAGES OF THIS PROCESS

- Produced electric potential
- Low operating cost
- long life span
- saving cost
- easy operate
- pollution control

DISADVANTAGES OF THIS PROCESS

- Worm does not survive for long time.
- Difficult to Handel worms
- Cost of electrode is high
- Because of a uniform generation of electricity circuit will be failed.

APPLICATION

- Domestic purpose
- Electricity generation
- Fertilizer industry
- Farms
- Agriculture university
- Biotechnology

Discussion:

The different physico-chemical parameters of soil before and after mixing with different vermicompost of combinations of sugar mill sludge and distillery influentswith animals dungs (cow, buffalo, goat and pig) was observed. There was significant increase in the level of TOC, TKN, TK, TP and TCa whereas, the significant decrease was observed in pH, EC and C/N ratio in vermicompost of different combination with animal dung There was a significant increase in total Kjeldahl nitrogen (TKN) in cow dung, total available

phosphorous (TAP) in distillery effluents, total potassium (TK) in distillery effluents, total calcium (TCa) in sugar mill effluents+buffalo dung level and significant decreased in C/N ratio in distillery effluents +cow dung, total organic carbon (TOC) in sugar mill effluents, electrical conductivity (EC) in cow dung of final vermicompost with respect to initial feed mixture were observed. The present study the significant physico-chemical parameters of soil before and after mixing with vermicompost of soil of sugar mill effluents, distillery effluents and different animal dung.The pH was significantly changes slightly basic to neutral or slightly acidic in soil after mixed with the vermicompost of different combinations of industrial effluents. The maximum low pH (6.6±0.12) was observed in soil with vermicompost of sugar mill effluents +buffalo dung (in 1:1 ratio). The significant increased EC was observed in soil with adding of different industrial vermicompost and high EC was recorded in the soil with vermicompost of sugar mill effluents (2.9±0.08 dS/m). The vermicompost of sugar mill effluents+cow dung showed that the TKN value was significant high (11.0±0.05 g/kg) in soil after mixing that vermicompost. The C/N ratio was decreased in the in soil if added vermicompost of sugar mill effluents +distillery effluents(1:2 ratio) in soil.

Conclusion:

As a conclusion, the vermicomposting process is a method which can convert agricultural waste into valuable vermicompost which produces high voltage.

- The increase of compartments increases the voltage produced. The voltage produced by one compartment of vermicompost is equivalent to the voltage produced by one dry cell. Based on the experiment, it is concluded that the vermicompost generates electricity and light up the LED. The vermicompost can be used in battery to replace the chemicals used. This research can be upgraded in further research whereas this battery of vermicompost can replace ultimately the usage of chemical electrolyte in dry cells.
- In this process produce 2.52 Voltage in vermicomposting process.

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