A Review on Different Composting Techniques using Waste Sugar Cane and Pressmud Mixtures

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Abstract **-- The present study was conducted to visualize characteristics of pressmud and methods of composting to produce an organic compost. Pressmud is a byproduct of sugar industry which mainly contains organic matter like fibers and lignin from sugarcane. There are several factors that affect the rate of composting, viz C:N ratio, moisture, temperature, pH and oxygen percentage in the composting pile. Methods of composting include windrow method, static pile method, enclosed vessel method and vermicomposting. The composting methods mainly focuses on degradation of organic matter by maintaining favorable environmental conditions and supply of sufficient oxygen to maintain an aerobic conditions in the composting pile. Organic compost produced from the above said methods are having huge advantages over the chemical fertilizers. Organic compost provides most of the macro and micro nutrients to the soil and also improves water holding capacity of soil. Long term usage organic compost helps the soil to maintain its fertility, improves the properties of soil and also reduces soil erosion by increasing the water holding capacity.**

Index Terms **-- Pressmud, Composting, windrow, vermicomposting.**

I. INTRODUCTION

Sugarcane is the main source for manufacture of sugar. In the recent times due to energy crises, scientists & researchers have realized the value of byproducts from sugar industry. Sugarcane is produced in 110 countries worldwide. India is one of the major sugarcane producing countries, also 50% of worldwide production is from India & Brazil. In India there are 579 sugar mills. sugarcane is processed to form sugar & biomass [7]. Main byproducts from sugar industry are baggase, pressmud & mollasses along with washwater used for maintaining the sugar industry. Molasses is used as raw material for production of alcohol in distilleries. Baggase mainly contains sugarcane fibers & hence is used in boilers for generation of steam in sugar industry [1]. Pressmud contains components like lignin and fiber pith which has plenty of application in biochemical & microbial field.

Due to higher dependency on agricultural aspect, the demand for organic compost is huge [2]. Hence, now a days the scientists and researchers are trying to find new and faster ways to decompose the pressmud to form organic compost, which will be completely organic in nature & does not contain any artificial chemicals as nutrients.

II. MATERIALS AND METHEDOLOGY

Composition of Pressmud

Sugarcane contains about 12% to 15% of sugar by weight and each tonne of sugarcane crushed produces 70 to 90 kg of press mud. The typical characteristics of pressmud are as follows [1]:

Table 1 characteristics of pressmud

Sl. No.	Nutrients	Percentages
1	Moisture	50 to 65
2	Fiber	20 to 30
3	Crude Wax	7 to 15
4	Sugar	5 to 12
5	Crude Protein	5 to 10
6	Nitrogen	2 to 2.5

Some trace amounts of silicon, iron, manganese, calcium, magnesium oxide & phosphorus pentoxide are present.

Factors affecting composting process

Composting is mainly microbial driven process. The activity of microorganisms depend on various environmental factors and the relation between them is highly complex. Few of the important factors affecting the microbial activity in composting process are : organic matter, moisture, pH, temperature & percentage of oxygen [8].

Organic Matter

In composting process microbes breakdown organic matter to extract energy & nutrients essential for their survival & growth. carbon & nitrogen are the most critical nutrients which affect microbial growth. Carbon is both source of energy and basic building block for the microorganisms. The ideal C:N ratio during the initial stage of composting is 30:1. As the composting

process continues the carbon content goes on reducing, due to the fact that, microorganisms when decompose organic matter 2/3rd of carbon is converted into CO_2 and remaining 1/3rd of carbon along with nitrogen is converted into nutrients. Hence at the end of composting C:N ratio will be nearer to 10 to 15:1.

Moisture Content

Maximum moisture content should be kept at levels that allows composting to be aerobic. For materials containing additional fibers, moisture content above 60% is permissible. The ideal moisture content for composting is 50 to 60% by weight. If moisture content is very less, then the microorganisms will deprive of water intern inhibiting its activity. Whereas if moisture content is more, most of the voids will be filled with water and intern cause anaerobic condition. Moisture also regulates temperature of composting pile, which is also very important factor for composting.

pH

The optimum range of pH for aerobic composting is 5.5 to 8.0. It provides a favorable environment for the growth of microorganisms. If the pH of compost pile increases to more than 8.0, then some of nitrogen is lost in gaseous form & hence it is important to maintain or observe the pH. pH varies during composting process and also throughout the pile. Proper sampling for pH is significant due to variation of pH.

Temperature

Temperature is one of the important parameters that control the activity of microorganisms & intern control the rate of decomposition. The optimum temperature for microbial growth is 55^0C to 70^0C. As the temperature increases, activity of thermophelic bacteria increases, which cause higher rate of organic decomposition. Temperature above 70^0C inhibit the microbial activity. Some of the technique for adjusting temperature are aeration, turning & changing moisture of the composting pile.

Oxygen Demand

Composting process can occur both in aerobic and anaerobic conditions. Usually aerobic composting is three times faster than anaerobic conditions. Aerobic composting can continue even if the oxygen content is upto 5% and the optimum oxygen content required for composting is 10%. As discussed earlier carbon content in organic matter is converted to CO_2, during this oxygen is utilized. Hence if oxygen is not sufficient, anaerobic conditions may prevail & produce undesirable odours. Turning is the most common way of controlling aeration. Most of the oxygen measuring equipments are costly, hence if a compost pile is odour free, it may be rightfully assumed that sufficient oxygen content is present in composting pile.

Methods of Composting

Most frequently used composting methods are

- Windrow Composting.
- Static Pile Composting.
- Enclosed vessel composting.
- Vermicomposting.

Windrow Composting

Windrow composting is one of the most widely used composting technique. It involves formation of long composting piles of Pressmud, called "Windrows" and aerating them periodically by either manually or mechanically. Ideal height for windrows vary from 1.50 to 2.00m and width varies from 4.00 to 4.50m [5]. The size of the pile also determines the interior temperature of pile, i.e. if pile is too small ,there will not be sufficient heat generated due to higher surface area and intern inhibit the activity of thermophelic bacteria. It involves mixing of pile using tractors & tilters. It is a labour intensive method. In case of higher atmospheric temperature, windrows are prepared under shelter to prevent excess of moisture. Height of the pile also depends on size of tilters. Due to its simplicity & efficiency, it is one of the most widely used composting method.

Figure 1 Windrow composting with tilting operation.

Static Pile Composting

It requires a raw material which is homogenous and produces compost at a faster rate. In this method the organic waste is mixed in large piles and aeration is carried out passively or by mechanical means. In passive aeration bulking agents like wood chips, shredded newspapers are used to ensure the movement of air from bottom of the pile to top and in mechanical aeration perforated pipes are laid beneath the compost pile and through compressors air is forced into the pile. To control the odour, finished compost is spread on top of the pile. In this method there will be no turning of composting pile and hence preparation of pile needs to carried out carefully to have higher percentages of voids which helps in maintaining optimum percentage of oxygen.

Figure 2 Static Pile composting with aeration.

Enclosed Vessel Composting

It is mainly used for commercial production of organic compost. For faster composting process, more control over the environmental factors are necessary and the same can be achieved by the use of closed vessel. Some of the environmental factors include temperature, moisture, oxygen content etc. The enclosed vessel may be a drum, silo, concrete lined trench or an entire building which is enclosed [5]. The vessel may be mechanically turned for aeration of composting material. This method produces compost within few weeks and some more time is required to cool and inhibit the activity of microorganisms.

Figure 3 Enclosed Vessel Composting

Vermicomposting

Earthworms are most important soil dwelling organisms for soil formation. Vermicomposting is a mesophelic process and it includes ingestion, digestion & absorption of organic waste carried out by earthworms. As earthworms ingest the organic matter, microorganisms within the earthworm partially digest and through excretion "vermicast" are formed. The vermicast is rich in microorganisms and partially digested organic matter, which intern undergo complete digestion process. African Night Crawler (Eudrilus Euginiae), Tiger Worm (Elsinia Foetida) are some of the species used for vermicomposting in India. Moisture is one

more important factor which controls vermicomposting process [7]. Favorable conditions needs to be maintained for survival & growth of earthworms. It takes around 3 to 4 months for complete composting process and end product will be of highest quality.

Figure 4 Vermicast from Earthworms.

Figure 5 Vermicomposting Pits.

Comparison of Organic Compost and Chemical Fertilizer **[4]**

Sl.No.	Organic Compost	Chemical Fertilizer
1	In addition to releasing nutrients, organic compost breakdown, improve the structure of soil and also increases its ability to hold water & nutrients.	In addition to releasing nutrients, chemical fertilizer breakdown, but it reduces the water holding capacity & nutrient as time passes.
2	These are renewable, Biodegradable, Sustainable & Environmentally friendly.	Chemical fertilizer are nonrenewable and cause soil erosion.
3	There is little to no risk of toxic buildups of chemicals & salts that can be deadly to plants.	There is a risk of toxic buildup of chemicals like arsenic, cadmium & uranium in the soil & salts that can be deadly to plants.
4	Microorganism are required to break down & release nutrients into the soil. Since they need warmth & moisture to do their jobs, the effectiveness of organic fertilizer is limited seasonally.	Decomposes directly into soil.
5	Organic compost are primarily made from renewable sources.	Chemical fertilizers are primarily made from nonrewable sources, including fossil fuels.
6	Long term use of organic compost increases fertility of soil.	Long term use of chemcial fertilizer can change the soil, pH, upset benificial microbial ecosystem, increase pests and even contribute to release of greenhouse gases.

Characteristics of Organic compost **[4]**

- Contains 25 to 30 % of organic matter.
- Contains major plant nutrients like N, P, K, Ca, Mg & S and minor elements like Fe, Mn, Cu, B & Mo.
- It costs 15 to 20 % less than Chemical fertilizer.
- It improves structure, texture & quality of soil.
- The microbes produce Enzymes, Auxins & other growth regulators, Amino acids & many other organic acids which help in proliferation of root hairs.
- It rectifies the micronutrient deficiency of soil.

III. CONCLUSION

In the recent times due to industrialization, deforestation and increase in cropland area, the soil erosion has been increased drastically. The fertile soil along with nutrients are getting eroded and land is becoming deficient in fertility. Chemical fertilizers can be used as a source of nutrients but it has certain disadvantages in long term usage, ultimately causing pollution in the

environment. On the other hand organic compost is a very feasible and reliable product that do not harm the environment and also provides all the nutrients to the soil and increase its water holding capacity.

There are several methods, that can be used for the production of organic compost. Each of the method discussed above have their specific advantages. The selection of a particular method for composting should depend on type of raw material available, quantity of raw material present, amount of space and time available and economical considerations. All the organic composting methods have same basic principle of working, i.e. organic waste is heaped into piles and aeration is provided passively or mechanically, to maintain favorable environmental conditions. Due to which microbial activity increases and intern degrade the organic waste material into stabilized organic compost, which do not contain any artificial inorganic chemicals.

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