

A REVIEW ON THE FACTORS INFLUENCING THE RATE OF SUBSTRATE UTILISATION OF ORGANIC CONTENT OF MUNICIPAL SOLID WASTE

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ABSTRACT

Municipal authorities in the country provide solid waste management as basic essential service to keep the cities clean. In India on an average 188,500 tonnes per day of municipal solid waste (MSW) is generated. To treat this much quantity of waste the solid waste management system should be efficiently managed. Bio composting and Vermicomposting are two eco-friendly ways to treat the organic waste but the time taken by these processes to decompose the waste is very high hence it is necessary to study the basic parameters which affect the rate of substrate utilization. The following paper gives the review of the parameters affecting the rate of substrate utilization of organic waste from MSW by vermicomposting and bio composting.

Keywords: Bio Composting, Eco-Friendly, MSW, Rate Of Substrate Utilization, Vermicomposting

I. INTRODUCTION

In India on an average 188,500 tonnes per day of municipal waste is generated out of which the organic waste is about 40 to 60%. Disposing this huge amount of waste has to be environmental friendly and cost efficient. The anaerobic decomposition of the waste is done through landfills but those have various environmental as well as cost concerns also the leachate generated from the landfills contaminates the groundwater in surrounding areas is of major concern these days. Bio composting and Vermicomposting are the two eco-friendly methods for the decomposition of organic municipal waste.

Composting is basically a natural biological process for decomposition of organic waste into stabilized product. But some specific environmental conditions are must for this process to happen naturally. Hence human has intervened this natural process by providing combination of proper environmental conditions and adequate time. Composting transforms readily available nutrient and energy sources into carbon dioxide, water, and a complex form of organic matter which is compost. The process can be made efficient by controlling the rate of decomposition which in turn depends on factors such as P^H , moisture content, carbon to nitrogen ratio, oxygen, temperature of the waste etc.

Bio composting is process of decomposition of the organic waste by naturally occurring microorganisms. In the process of composting, microorganisms break down organic matter and produce carbon dioxide, water, heat,

and humus, the relatively stable organic end product. Under optimal conditions, composting proceeds through three phases: 1) the mesophilic, or moderate-temperature phase, which lasts for a couple of days, 2) the thermophilic, or high-temperature phase, which can last from a few days to several months, and finally, 3) a several-month cooling and maturation phase. Different communities of microorganisms predominate during the various composting phases. Initial decomposition is carried out by mesophilic microorganisms, which rapidly break down the soluble, readily degradable compounds. The heat they produce causes the compost temperature to rapidly rise. As the temperature rises above about 40°C, the mesophilic microorganisms become less competitive and are replaced by others that are thermophilic, or heat-loving. At temperatures of 55°C and above, many microorganisms that are human or plant pathogens are destroyed*. Because temperatures over about 65°C kill many forms of microbes and limit the rate of decomposition, compost managers use aeration and mixing to keep the temperature below this point.

During the thermophilic phase, high temperatures accelerate the breakdown of proteins, fats, and complex carbohydrates like cellulose and lignocelluloses, the major structural molecules in plants. As the supply of these high-energy compounds becomes exhausted, the compost temperature gradually decreases and mesophilic microorganisms once again take over for the final phase of “curing” or maturation of the remaining organic matter. (Nancy Trautmann and Elaina Olynciw-“Compost Microorganisms”)

Vermicomposting is the process in which the earthworms use organic municipal waste as food and produce the by-product that is rich in nutrients contents and can be used for the enrichment of soil. Vermicomposting is done by slow degradation of organic matter by earthworms which are of various species i.e. *Eisenia foetida*, *Perionyx excavates* etc. Also process vermicomposting do not have any odour problems while decomposition. Hence the optimal environmental factors required for successful composting of the waste are to be determined.

II. LITERATURE REVIEW

Reference 2.1

ENVIRONMENTAL FACTORS AFFECTING VERMICOMPOSTING OF MUNICIPAL SOLID WASTE

By G.Amaravathi & R.Mallikarjuna Reddy (2015)

Principle Findings

- Various factors affecting the rate of vermicomposting are defined viz; temperature, moisture, pH.
- The optimum environmental conditions for each factor are found out.
- The optimum moisture content for the vermicomposting with the earthworm species *E.foetida* and for *P.excavatus* is in the range of 50.3 to 57.8%.
- The optimum temperature for the vermicomposting is 27⁰c.
- The P^H should be always less than neutral and for the given research it is 6.2.

Table 1.1

<p>Reference 2.2</p> <p>A Review on Vermicomposting of Organic Wastes</p> <p>By Usman Ali & Nida Sajid</p>
<p>Principle Findings</p> <ul style="list-style-type: none"> • The paper describes the vermicomposting process as the most eco-friendly way to decompose organic waste. • Also integrated approach of composting and vermicomposting provides better results. • Further it is given that codigestion of organic waste with microorganisms as well as earthworms under controlled conditions gives better decomposition. • The factors affecting the rate of decomposition for process of vermicomposting are defined as feeding, stocking density, P^H, C/N ratio, temperature and moisture.

Table 1.2

<p>Reference 2.3</p> <p>Study of Influence Factors in Municipal Solid Waste Management Decision-making</p> <p>By KUI LI</p>
<p>Principle Findings</p> <ul style="list-style-type: none"> • In order to find out the influence factors in municipal solid waste management decision-making, incineration and anaerobic fermentation techniques are selected as example for comparison. • The two methods are compared on various factors like geographical conditions of the given area, transportation, moisture content, solid content, toxicity, temperature, energy generation, costing etc. • In the study it is seen that there is no clear definition on which factor has the highest degree of influence for the decision-maker. The priority of influence factors is depended on the local condition and subjective choice of decision-maker.

Table 1.3

<p>Reference 2.4</p> <p>MUNICIPAL SOLID WASTE COMPOSTING: BIOLOGICAL PROCESSING</p> <p>By Tom L. Richard</p>
<p>Principle Findings</p> <ul style="list-style-type: none"> • In the given paper composting is explained as slow and natural process which can be optimised by controlling various environmental conditions and adequate time. • Controlling process is mainly dependant on the rate of decomposition which in turn depends upon various factors like as P^H, moisture content, carbon to nitrogen ratio, oxygen, temperature of the waste etc. • Carbon and nitrogen are the main limiting factors for composting process. C:N ratios for composting

MSW are 25:1 to 40:1 by weight, these ratios may need to be altered to compensate for varying degrees of biological availability.

- Moisture is essential for decomposition as the maximum decomposition occurs in thin liquid films on the surface of the particle of organic matter. Balance between microbial activity and oxygen supply affects moisture content. The optimum moisture content for high rate composting of MSW is recommended as 50 to 55%.
- Oxygen content and temperature both vary with respect to microbial activity which consumes oxygen while decomposition of organic matter and generates heat. The oxygen content must be 10-12 % (ideally 16-17%) and temperature must be 45 to 59^oc for highest rate of decomposition.

Table 1.4

III. INFERANCES

The main objective of this study is to review the various factors affecting the rate of decomposition of the organic waste from MSW. Based on literature review it is inferred that The factors which majorly impact the process are

- Moisture content (suitable range 50-55%),
- Solid content,
- Oxygen content (10-12%),
- Temperature (45 to 59^oc),
- C/N ratio (25:1 to 40:1 by weight),
- P^H (preferably slightly less than neutral).

The study also implies that the main priority of influence factor depends upon the local conditions and available sources at the place of decomposition. Thus it is anticipated that after understanding the local conditions and available resources, experimental investigation can be carried out to evaluate optimum conditions of decomposition for different parameters and to suggest guidelines for the best suitable combination of range of these factors for highest rate of decomposition.

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