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Aplicacion de Efluentes de Destileria Para Fabricacion de Bio-fertilizantes

Introducción

Con el transcurrir de los años los ingenios azucareros se han venido diversificando mediante la elaboración de distintos productos y servicios los cuales han proporcionado un enorme valor agregado a los mismos. La producción de alcohol etílico de diversas clases a partir de mieles y jugos de caña, en plantas anexas a un Ingenio Azucarero, ha cobrado mayor importancia debido a dos factores principales:
1. Disponibilidad de materia prima. Al obtenerla del ingenio azucarero generalmente se utiliza melaza o miel final, lo cual proporciona la ventaja de producir alcohol sin disminuir la producción de azúcar.
2. El uso de vapor de escape de turbinas producto de la cogeneración, el cual favorece el balance energético total del sistema.

El principal efluente que se obtiene del proceso de destilería es la vinaza. El objetivo principal del tratamiento de la vinaza es asegurar un correcto tratamiento de la carga orgánica, asegurar una descarga segura del efluente procesado y convertirlo en un producto útil con un valor agregado.

La cantidad y propiedades de la vinaza generada dependen de la materia prima que se use en el proceso de producción de alcohol. A continuación se presenta una tabla con las cantidades y características típicas de la vinaza.

Existen hoy en día diversos procesos para el tratamiento de la vinaza los cuales dan como resultado productos que brindan una gama de opciones tanto para su utilización, como para su comercialización. A continuación se presenta el sistema de Compostaje de la Vinaza con Cachaza.

Compostaje de La Vinaza con Cachaza

Compostaje es un proceso biológico aeróbico en el cual microorganismos procesan el material orgánico contenido en la vinaza, la cual, al mezclarla en proporciones y condiciones controladas con cachaza, producen un material llamado compost, el cual es de gran beneficio para el crecimiento de las plantas ya que le proporciona los nutrientes necesarios para su crecimiento y desarrollo; se caracteriza principalmente por ser un material estable, libre de microorganismos patógenos y, como se mencionó anteriormente, puede ser aplicado al campo con el beneficio de agregar valiosos nutrientes y minerales. La descomposición de la materia orgánica es llevada a cabo por microorganismos en condiciones controladas, los cuales consumen oxígeno (O_2) mientras se alimentan de la materia orgánica. Esto conlleva a la generación de calor, dióxido de carbono y vapor de agua, asimismo también ayuda a reducir el peso y volumen de la cachaza. Vale la pena mencionar que

Application of Distillery Effluents for Manufacture of Bio-fertilizers

Introduction

During the past years, sugar mills have been diversifying by means of elaborating different products and services, which have provided an enormous added value. The production of different ethyl alcohol classes, from molasses and from sugar cane juice, in annexed plants to sugar mills, has acquired greater importance due to two main factors:
1. Availability of raw material. When it is obtained from the sugar mill, C molasses is generally used, which provides the advantage to produce alcohol without diminishing sugar production.
2. The use of exhaust steam from turbines, a product of co-generation, which favors the system's total energy balance.

Vinasse is the main effluent from a distillery. The principal objective of vinasse treatment is to assure a proper treatment of the organic matter contained in it to assure a safe discharge of the processed effluent, and convert it into a useful product with market value.

The quantity and properties of the generated vinasse, depends on the raw material used in the distillery's process. Next is presented a table with the different characteristics of the vinasse, depending on the material used for the process.

Today there exists diverse processes for vinasse treatment, all of them result in products that offer a range of options for their use and for their commercialization. Next we will present the vinasse composting system with filter cake.

Composting of Vinasse with Filter Cake

Composting is an aerobic biological process in which microorganisms process the contained organic material in the vinasse, which, when mixed in controlled proportions and conditions with filter cake, produces a material called compost. This is of great benefit for the plant's growth since it provides the necessary nutrients for growth and development. It is characterized mainly for being a stable material, free of pathogen microorganisms and as mentioned previously, can be applied to the field, with the benefit of adding valuable nutrients and minerals to it. The decomposition of the organic matter is carried out by microorganisms in controlled conditions, which consume oxygen (O_2) while they are fed the organic matter. This generates heat, carbon dioxide and vapor of water, which aids to reduce the weight and volume of the filter cake. It

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is very important to mention that this option allows to have a plant with zero discharge of vinasse.

During the composting process, it is important to have a suitable control of the following conditions:

Table No.1 Characteristics of the vinasse depending on the raw material from sugarcane. (Ref: "Treatment of Vinasse and Thin Slop")

Variable	Juice	Molasses C	Molasses B
Volume (Lit/Lit Alc)	12 – 15	10 - 12	6 – 8
CDO (mg/Lit)	30,000 – 35,000	100,000 – 120,000	80,000 – 90,000
BDO (mg/Lit)	15,000 –17,000	40,000 – 50,000	35,000 – 40,000

Homogeneity: Homogeneity between the organic matter and the microorganisms. This is obtained by means of a correct mixing process of vinasse, filter cake and the culture of microorganisms, which aids these microorganisms to have a fresh substratum to consume. Also it contributes to let the heat escape generated during the degradation of the organic material, which simultaneously aids to maintain the temperature and humidity uniformly throughout all the material.

Aeration: The aeration provides the necessary oxygen to the microorganisms for its growth and development. It also contributes to the removal of heat, vapor of water and other gases which are generated during the decomposition process. In order to have an active composting process, a minimal concentration of 5% oxygen in the pores is needed, throughout all the material.

Moisture: A correct control of the moisture present in the material is necessary to help the metabolic process of the microorganisms. The water also provides the medium for the transport of the nutrients and microorganisms, as well as the necessary medium for the chemical reactions. It has been observed that the moisture content in the material, must be preferably between 50% - 60%. Having excessive moisture will cause a lack of oxygen, which will affect the process since it is aerobic by nature, diminishing the metabolic process of the microorganisms.

Nutrients: The nutrients that the microorganisms need are C, N, P and K, which help in their growth and development throughout the process. The carbon is used by the microorganisms as a source of energy as well as for growth, while nitrogen is essential to cover the requirement of proteins and for the reproduction process.

Temperature: Composting takes place within two temperature ranges:
Mesophilic (10 to 40 C°)
Termophilic (Above of 40 C°)

A range of 55 to 60 C° is considered the optimum, since it helps to eliminate pathogen microorganisms, weed seeds and fly larvae. Temperatures over these values could help to eliminate microorganisms that help the process. The composting reaction is faster in the Termophilic temperatures, than in the Mesophilic.

Porosity: It is a measure of the air space within the material of compost, which determines the resistance to the air flow. The favorite range is 450-500 kg /m^3.

Next are the three methods most used to produce compost:
- Pit Composting
- In-Vessel Composting
- Surface Windrow Composting,

which we will illustrate in more detail for being the most used.

Pit Composting

Composting is done in concrete lined pits. Filter cake & vinasse is filled in the pit in the ratio of 1:2. The mixed procedure of biomass is carried out in the pit; some times this process becomes anaerobic in the pits.

In-Vessel Composting

In this method the materials are introduced in a vessel, which presents air intakes in the sides to maintain its ventilation. This method is used for small volumes of filter cake to process.

Surface Windrow Composting

It is the most used and the lowest cost method. Filter cake is arranged in the form of windrows on plane hardened surface. Vinasse is sprayed on each windrow at specific intervals along with turning, helps in homogenizing the entire mass which maintains uniform temperature and moisture with effective aeration and oxygen supply.

The composting process cycle is described next. The time of the composting cycle can be carried out in 45 or 60 days. Following is the procedure for a cycle of 45 days:

- 1st to 5th day:
  Windrow dressing, moisture reduction & culture inoculation.
- 6th to 35th day:
  Moisture maintained by spraying vinasse.
  Homogeneity maintained by turning.
- 36th to 45th day:
  Curing, aging and stabilization.
  Moisture reduction.

Procedure of composting for a 60 day cycle:

- 1st to 5th day:
  Windrow dressing, moisture reduction & culture inoculation
- 6th to 50th day:
  Moisture maintained by spraying vinasse.
  Homogeneity maintained by turning.
- 51st to 60th day:

Curing, aging and stabilization.
Moisture reduction.

The duration time of the composting cycle can vary depending on the environmental conditions of the place in which it is carried out, also of the filter cake and vinasse properties that are used, and on the practices carried out in the process.

The consumption of vinasse per metric ton of filter cake varies from 1.5 to 2.5 m^3, depending on the concentration of vinasse that is being used.

Typical composition of bio-compost obtained during the process can be found in the next table:

Table No.2 Typical Composition of Compost Produced (Ref. "Praj. R& D Center")

Variable	Value
Bulk Density	200 – 400 Kg/m^3
Solids	50% w/w Min
Moisture	30 – 40% w/w
Ash	30 – 45% w/w
Ph	7.0- 7.5
Nitrogen	2.5 – 3.0% w/w
Fosphorous	2.5 – 3.0% w/w
Potasium	3.0 – 4.0% w/w
Calcium	1.0 – 4.0% w/w
Magnesium	2.0 – 9.0% w/w

In compost applications done in India, an increase of 8% in the cane yield per hectare has been observed, when it is compared with the application of fertilizers rich in nitrogen, phosphorus and potassium.

Conclusions

We conclude that the compost provides many benefits, among which we can mention the following:

- It improves the soils physical, chemical & biological properties.
- Reduces the soil bulk density.
- Improves the aeration & drainage of dense soils.
- Improves water holding capacity of sandy soil.
- Increases the ionic exchange capacity of the soil, and its ability to absorb nutrients.
- A viable solution due to the current rise of fertilizer prices.

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This article was presented at the ATALAC 2008 Congress. SJ