

Article

Time Effect on Aerobic Composting Method for Temperature and pH from Brem Waste

Kindriari Nurma Wahyusi^{1*}, Ummi Muashomah¹, Annisa Bella¹, Nur Aini Fauziyah¹

1 Department of Chemical Engineering, Faculty of Engineering, Universitas Pembangunan Nasional “Veteran” Jawa Timur (UPN), Gunung Anyar, Surabaya 60294, Indonesia

E-mail: kindrinurma@gmail.com, aini.zierra@gmail.com

*Corresponding author: kindrinurma@gmail.com | Phone number: -

Received: 12th August 2021; Revised: 27th September 2021; Accepted: 30th October 2021;
Available online: 15th November 2021; Published regularly: May and November

Abstract

This research addressed to utilize brem waste to be compost with the addition of M-Bio activator using aerobic composting method. Brem waste was collected from brem industry, UD. Tongkat Mas, located in the Caruban, Madiun, East Java. The main material was brem waste (1 kg) with additional materials of eggshell flour (300 g) and M-Bio activator. Here, we considered every time and the pH was measured every time interval. This brem waste was included in organic waste. This organic waste had a high water content so it can easily decompose. The temperature of compost increased as addition of M-Bio activator. The best properties was shown by the compost III that met with the standards SNI 19-7030-2004.

Keywords: Compost, Brem waste, aerobic composting, effect of time, pH.

1. Introduction

Brem is one of the traditional foods formed from fermented sticky rice tape which has a distinctive taste and smell. In the process of making brem, the waste from processing brem is the residue from the process of pressing glutinous tape. In East Java, Brem processing center is located in Madiun. Brem waste generated from the Brem industry in Caruban, Madiun, was 50-100 kg per day or about 1.5-3 tons per month [1]. Brem waste can be used and further processed as raw material for making lunkhead, animal feed, bioethanol and compost. However, most of brem waste was just thrown away without further processing, so that the brem waste can cause problems in the surrounding environment [2].

There was evidence that brem organic waste has a fairly large water content in the material so that brem waste will quickly undergo a process of deterioration. From the previous study, Purwasih had characterized the chemical composition in

100 grams of brem waste [1]. This composition can be seen in Table 1.

Table 1. Chemical Composition of Brem Waste

Chemical Composition	Wt.%.
Carbohydrate	14.7%
Starch	13.2%
Water	16%
Total Acid	15%
Fat	0.11%
Protein	9.5%
Food Fiber	10.6%

The large water content in brem waste can be a breeding ground for microbes, especially supported by an acidic pH value ranging from 4.2 to 4.5 [3]. The high content of organic compounds in brem waste causes microbes to biologically degrade these organic compounds into simpler compounds [4]. If there is no further processing of this brem waste, brem waste will have the potential to pollute the surrounding environment.

The high water content in this brem waste can cause the process of decomposition of waste to be faster. Therefore, to reduce the impact of pollution from brem waste, it can be used as compost.

Compost had been developed before by adding activator. Islam et al. [5] had made compost from tea. The results suggested that the best composition of compost:water was: 1:2.5, 2 days of extraction time and the compost tea should be utilized immediately after the extraction, since the storage reduced the microbial populations. Surahman [6] had succeeded in composting market vegetable waste with the effect of M-Bio concentration on the speed of composting. The results showed that there was an effect of M-Bio concentration on the composting speed of market vegetable waste, the fastest composting concentration was 0.1 M or 10 ml of M-Bio per 100 ml of sugar water. In addition, at 2015, Kurniati [7] had processed palm waste into compost with M-Bio activator. This compost had been used for growing oyster mushrooms. However, no one had ever developed brem waste as compost, especially with the addition of M-Bio activator.

This study addressed to determine the effect of giving M-Bio activator (multifunction bio-activator) and the composting time on the temperature and pH from brem waste. The composting process was using aerobic method. The utilization of composting from brem waste significantly improved the public's economy.

2. Material and Method

Brem waste was collected from UD. Tongkat Mas, Madiun. Meanwhile, the aerobic composter was made with our own design as shown in Fig. 1. M-Bio activator, aquades, granulated sugar, and egg shell flour were added in compost.

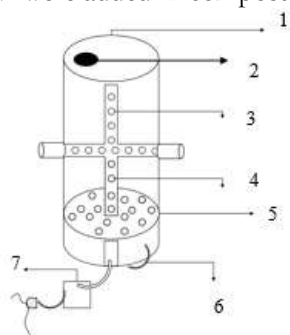


Fig. 1. Composter design

The explanation of the numbering in Fig. 1 are 1) close composter, 2) temperature sampling hole, 3) airway pipe, 4) air hole, 5) sieve buffer, 6) leachate faucet, and 7) aerator, respectively.

In this work, we used 1000 grams of brem waste, 10 ml of M-Bio activator, 15 grams of sugar, 300 grams of eggshell flour, with 2 variables, namely variations in the volume of the M-Bio activator solution of 50; 75; 100; 125; and 150ml with a composting time of 2; 4; 6; 8 ; and 10 days.

Firstly, we had to prepare M-Bio activator first with by heating 1 liter of distilled water to a temperature of 45°C. Then 15 grams of granulated sugar was dissolved with the distilled water which had previously been divided into 50; 75; 100; 125; and 150ml. Measure 10 ml of M-Bio solution up to 5 times. 10 ml of M-Bio was dissolved into the mixed sugar water solution. The mixture was cooled for 2 hours. Finally, M-Bio solution was ready to use.

After preparing the M-Bio activator, we started to prepared brem compost. A thousand grams (1000 g) of brem waste and 300 g of eggshell flour were mixed evenly then each composter was added with M-Bio solution which has been added to a sugar solution with these variations (see Table 2).

Table 2. Compost sample nomenclature

Name of sample	Composition
Compost I	1000 g of brem waste and 300 g of eggshell flour were mixed 50 ml of sugar water solution and 10 ml of M-Bio activator
Compost II	1000 g of brem waste and 300 g of eggshell flour were mixed 75 ml of sugar water solution and 10 ml of M-Bio activator
Compost III	1000 g of brem waste and 300 g of eggshell flour were mixed 100 ml of sugar water solution and 10 ml of M-Bio activator
Compost IV	1000 g of brem waste and 300 g of eggshell flour were mixed 125 ml of sugar water solution and 10 ml of M-Bio activator
Compost V	1000 g of brem waste and 300 g of eggshell flour were

	mixed 150 ml of sugar water solution and 10 ml of M-Bio activator
--	---

Then the aerator was turned on with an aeration speed of 50 ml/second. Composting was carried out for 2; 4; 6; 8; and 10 days on each composter. Then we had to observe and measure the temperature and pH of the compost that has been produced.

3. Results and Discussion

3.1. Effect of Composting Time on temperature

In the composting process, the temperature factor greatly affects the sustainability of the growth of microorganisms contained in a compost. Compost from brem waste with the addition of M-Bio activator is an aerobic composting process. During the composting process, the temperature changes where the longer the composting process takes place, the higher the temperature. At the beginning of the composting process, the temperature during the composting process will increase. However, after a few days of the composting process, the temperature during the composting process will decrease (see Fig. 2). The activity of various microorganisms during the composting process can be characterized by an increase and decrease in temperature during the composting process of an organic material [8]. The activity during the composting process indicates that there is a process of breaking down complex compounds in organic matter during the composting process.

In the fermentation process that occurs in organic waste, organic compounds will be broken down into a more complex form of protein and then decomposed into nitrate compounds. These nitrate compounds are often known as nutrients and are widely absorbed by plants because they are able to stimulate growth in plants. The mechanism that occurs in the composting process with the aerobic method can be seen as in Equations 1-3 as follows:

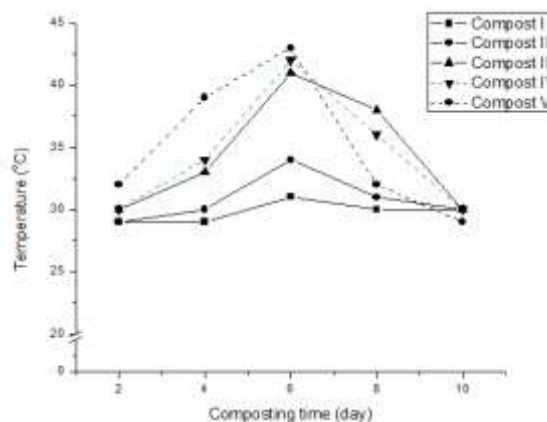
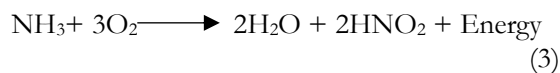
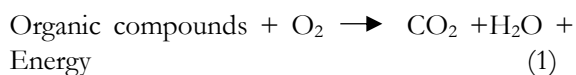


Fig. 2. The correlation between composting time and temperature

Fig.2 shows that in the composting process, the temperature of the compost increases as composting time and the more volume of M-Bio. Compost I shows a stable temperature around 30°C. However, as the M-Bio activator was added, the temperature fluctuation of the compost also increased. On the second to sixth day of the fermentation process takes place, the temperature of the compost increases. Nevertheless, on day 6 and day 10, the temperature in the compost decreased to near room temperature. The presence of microorganism activity during the decomposition process of organic matter contained in compost indicates an increase in temperature in the compost. These activities produce water vapor and heat in the compost pile and carbon dioxide, while the decrease in temperature is due to the completion of the decomposition process of organic matter in the compost.

At a temperature of 25-40°C, the microorganisms involved are mesophilic microorganisms, these mesophilic microorganisms are present in the early stages of

the composting process. After a few days the fermentation process takes place, thermophilic microorganisms will replace the role of mesophilic microorganisms so that the temperature in the compost pile will increase. Subsequently, the temperature of the material during the composting process will decrease with the active return of mesophilic microorganisms. The process of decomposition of organic matter in compost using sufficient aeration will produce water vapor and heat in the compost material during the composting process, therefore the temperature in the compost pile will increase during the composting process. In addition to water vapor and heat generated during the composting process, carbon dioxide is also the result of the composting process of a compost material using the aerobic method.

The composting process with the aerobic method is easier and requires process control that is not too difficult when compared to the anaerobic composting process [6]. The aerobic composting process produces more hygienic compost because the temperature in composting is of high value so that it can kill worm eggs and pathogenic bacteria contained in the compost. It also does not produce an unpleasant smell, therefore the aerobic composting process is more widely used when compared to the anaerobic composting process.

3.2. Effect of Composting Time on pH

The decomposition process of an organic material can be influenced by the presence of a degree of acidity (pH) in an organic material. The degree of acidity of a material greatly affects the growth of microorganisms during the composting process. Changes in the nitrogen element in the compost material into ammonia compounds are caused by the pH value of the material being too high [9], but the composting process will also be disrupted if the pH value of the compost material is too low.

Fig. 3 shows that the pH in the composting process has increased in proportion to the number of additions of M-Bio in the composting process and the length of time the composting process takes. From Fig. 3 it can be seen that on second to fourth day, the pH decreases. Meanwhile, after fourth day, the pH in the compost increased close to neutral. At the beginning of composting, the

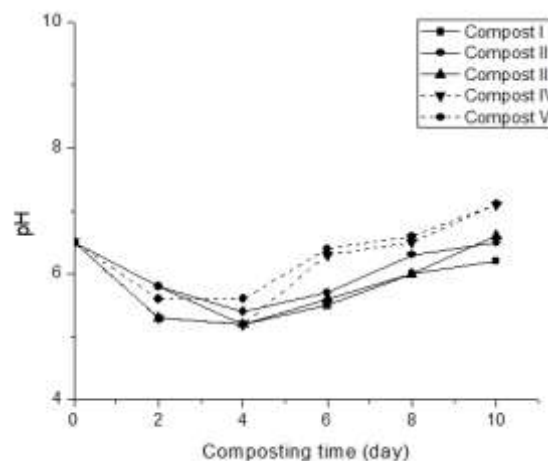


Fig. 3. The correlation between composting time and pH

pH of the compost tends to be slightly acidic due to the activity of reorganizing microorganisms in the compost which will decompose the organic matter and produce simple organic acids. Furthermore, microbes begin to convert nitrogen into ammonium so that the pH in the compost can increase, some of the ammonia compounds are converted into nitrate ions and undergo a denitrification process by microbes so that the pH value in the compost will increase and almost neutral. This view was echoed by another informant [10] who also investigated the relationship between pH and microbial activity in compost. They observed that at low pH conditions, microbes began to decompose cellulose into several minerals that were very useful for soil fertility contained in the compost. One of the products was ammonia which was alkaline. This was what made the compost more mature and neutral.

One of the waste that is a problem for the environment, for example, is egg shells. The egg shell itself has a composition consisting of 98.2% CaCO_3 , 0.9% Mg, 0.3% phosphorus, 3.3% protein compounds, 1.6% H_2O [11]. The very high content of calcium elements can be used as fertilizer and as an ingredient to neutralize the acidity of a fertilizer. Inside the egg shell there is a CaCO_3 content which when dissolved in water. CaCO_3 will release OH^- ions when reacted with water, this makes the number of hydroxide ions in the water increase so that the pH of the material will increase [12].

4. Conclusions

The compost from brem waste with time effect to pH of compost was synthesized successfully by aerobic method. The aerobic method was very appropriate for preparing compost from brem waste with an optimum composting time of 10 days. With a fairly short time, the compost was mature which was indicated by a neutral pH and odorless.

References

- [1] R. Purwasih, "Pemanfaatan Limbah Pabrik Brem Sebagai Bahan Baku Bioetanol Untuk Bahan Bakar Alternatif Pemanfaatan Limbah Pabrik Brem Sebagai Bahan Baku Bioetanol Untuk Bahan Bakar Alternatif," *Jurnal Pendidikan Teknik Mesin*, vol. 6, no. 02, Nov 2017, Diakses: Jun 13, 2021.
- [2] A. Afriyanti, "Pemanfaatan Residu Brem Sebagai Bahan Substitusi Pembuatan" Arenia Sticky Rice", *Jurnal Ilmiah Teknosains*, vol. 3, no. 1/Mei, 2017.
- [3] A. Purwanto, "Pembuatan brem padat dari umbi porang (*Amorphophallus oncophyllus* Prain)," *Widya Warta: Jurnal Ilmiah Universitas Katolik Widya Mandala Madiun*, vol. 38, no. 01, hlm. 16–28, Jan 2014.
- [4] M. Su'i, S. Supriana, dan S. R. Astutik, "Pemanfaatan Limbah Brem Sebagai Bahan Untuk Pembuatan Dodol," *Cakrawala*, vol. 5, no. 2, hlm. 107–114, 2011.
- [5] M. K. Islam, T. Yaseen, A. Traversa, M. Ben Kheder, G. Brunetti, dan C. Cocozza, "Effects of the main extraction parameters on chemical and microbial characteristics of compost tea," *Waste Management*, vol. 52, hlm. 62–68, Jun 2016.
- [6] E. Surahman, M. Ali, dan R. Fitriani, "Pengaruh Konsentrasi M-Bio Terhadap Kecepatan Pengomposan Sampah Organik Pasar," *Bioedusiana: Jurnal Pendidikan Biologi*, vol. 2, no. 1, Okt 2017.
- [7] F. Kurniati, "Pemanfaatan Limbah Aren dan Dkomposer MBio untuk Media Jamur Tiram Putih," *Hasil Reviewer*, 2015.
- [8] J. D. W. Adams dan L. E. Frostick, "Analysis of bacterial activity, biomass and diversity during windrow composting," *Waste Management*, vol. 29, no. 2, hlm. 598–605, Feb 2009.
- [9] C. Sundberg, S. Smårs, dan H. Jönsson, "Low pH as an inhibiting factor in the transition from mesophilic to thermophilic phase in composting," *Bioresourc Technology*, vol. 95, no. 2, hlm. 145–150, Nov 2004.
- [10] M. A. Hubbe, M. Nazhad, dan C. Sánchez, "Composting as a way to convert cellulosic biomass and organic waste into high-value soil amendments: A review," *BioResources*, vol. 5, no. 4, hlm. 2808–2854, 2010.
- [11] I. Putra, N. Ariska, dan Y. Muslimah, "Aplikasi Serbuk Cangkang Telur Dan Pupuk Kandang Terhadap Pertumbuhan Dan Produksi Semangka (*Citrullus Vulgaris* Schard) Pada Tanah Gambut Meulaboh," *Jurnal Agrotek Lestari*, vol. 5, no. 1, hlm. 8–21, Apr 2019, doi: 10.35308/jal.v5i1.1962.
- [12] N. Novianti, L. Fitria, dan U. Kadaria, "Potensi Cangkang Telur Ayam sebagai Media Filter untuk Meningkatkan pH pada Pengolahan Air Gambut (The Potential of Chicken Eggshells as a Filter Media to Increase pH for Peat Water Treatment)," *Jurnal Teknologi Lingkungan Laban Basah*, vol. 7, no. 2, hlm. 064–071, Nov 2019, doi: 10.26418/jtlb.v7i2.37234.