IOP Conference Series: Earth and Environmental Science

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International Conference on Research Collaboration of Environmental Science 2023 (ICRC-2023)
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IOP Conference Series: Earth and Environmental Science

Preface

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The International Conference Research Collaboration 2023 (ICRC) aimed to promote cooperation and collaboration between The University of Kitakyushu and other universities, specifically in Indonesia and Malaysia. This conference marked the third event in a series, with the first held at Airlangga University on March 5, 2018, and the second conducted online on April 25-27, 2021. During the conference, the consortium presented and published the research findings of 147 articles in the areas of environmental management, education, and technology. Moreover, it provided an opportunity for The University of Kitakyushu to engage with community members and academics interested in research within these fields.

ICRC 2023 extended an invitation to scholars and researchers to actively participate and contribute their knowledge and experiences to promote understanding and progress in environmental and sustainability matters within their respective countries. The conference provided a hybrid format, allowing participants to choose between attending in person or joining online. It aimed to foster innovation and exploration within the overarching theme of "Development of Science and Technology for Solving Environmental Problems." The conference focused on several specific subtopics, which include:

1. Water and Wastewater Treatment and Recycling
2. Environmental Education
3. Energy Management and Air Pollution Control
4. Environmental Culture and Conservation
5. Environmental Health and Sciences
6. Waste Management and Treatment
7. Soil and Urban Environment

This year, The University of Kitakyushu, Japan, hosted the third ICRC from June 2-3, 2023, featuring a hybrid conference format, followed by a workshop and training session in Kitakyushu, Japan, from June 4-6, 2023. There were 46 participants joining the on-site conference during the first and second day while the rest, around 265 participants from 78 universities and institutions around the world joining the conference virtually. Almost all the plenary speakers were attending the virtual session on the first day, while half of the invited speakers, which also coming from the Japanese industries and practitioners were joining onsite. Zoom was used as the meeting platform for the online participants.

We have chosen 40 excellent manuscripts to be published in the Earth and Environmental Science IOP Proceedings. We would like to extend our sincere appreciation to the conference chairwoman, esteemed keynote speaker, reviewers, parallel session moderators, and all the participants. We would also like to express our gratitude to IOP for publishing our conference proceedings. It is our hope that readers will find valuable information and knowledge within our proceedings. We apologize for any errors identified during the conference or within the published papers.

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The application of biodrying method for organic waste treatment in Universitas Trisakti, Jakarta

The application of biodrying method for organic waste treatment in Universitas Trisakti, Jakarta

A Minarti[1*], S Aphirta[1], S M P Marendra[1] and L Rahmiyati[1]

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Abstract. Universitas Trisakti has been attributed with many activities and has not been equipped with a proper solid waste management to recover the waste that may contaminate the environment. Biodrying becomes an approach of drying technique utilizing the heat generated by biological activities to degrade the organic waste and also acknowledged to be the proper technique to provide the raw material for Refuse Derived Fuel (RDF). This study aims to conduct the process of biodrying technique carried out in an acrylic chamber with the capacity of 18000 cm^3. The source of municipal solid waste supplied by the transfer waste facility in the area of Universitas Trisakti. Only organic waste was used during the biodrying process. Aeration rate was 3 l/min. The biodrying process was observed for 8 (eight) days which the activities of microorganisms were identified at the third days, shown by the condensation of the evaporated water released on the top and side walls of the biodrying reactor. Due to this condition, the designed reactor needs further innovation to avoid the condensation of evaporated water to raise the reduction rate of moisture content. This pretreatment study showed the absence of leachate which proves that the biodrying method has the potential to reduce the negative impact of unmanaged solid waste generation.

1. Introduction

Solid waste is considered to be a pressing environmental factual problem that occurs in urban areas. The generation of urban waste has been largely accused to be the cause of flooding and pollution into water bodies. Besides, solid waste is classified into types and composition that some of them take much longer time to decompose which most of them are disposed in the waters. In addition, municipal solid waste also has an organic composition that takes one to two weeks to decompose that basically consists of kitchen waste, food waste, vegetables, flowers, leaves and variety of fruits [2].

Solid waste processing technology with the concept of waste to value has been recognized to have the potential to reduce the volume of waste generation by up to 90% through an energy conversion process which determined by the density of waste, composition and percentage of moisture content of existing waste generation [8]. However, an application of waste to value technology, namely the process of drying waste (biodrying) remains to be a challenge for converting waste into biomass energy in an effective way due to the characteristics of urban waste that being heterogeneous and contains high water content [1].

In general, this biodrying technique has many similarities with composting techniques, however these two techniques show differences particularly in the purpose of each technique's process. Composting aims to fully decompose the raw materials or waste, eliminate odors and kill pathogenic bacteria. This composting technique can take up to several months. Meanwhile, biodrying technique aims to remove the maximum amount of moisture as much as possible in a fairly short time, approximately two to three weeks [6]. In addition, biodrying reactors can also act to provide the pre-treatment for solid waste with theshortest possible detention time so that it can produce high quality raw materials for Refuse Derived Fuels (RDF) [8].

Municipal solid waste is typically generated from daily human activities, both from domestic and non-domestic activities, included the activities in campus. Campus is categorized as a non- domestic source that has the potential to produce a high amount of municipal solid waste generation, especially during the day when lecture activities takeplace. Trisakti University is one of the largest campuses in the west Jakarta which located adjacent to several water channels. The large number of students who are being active, as wellas lecturers and other education staffs at Trisakti University may increase the production of waste generation and potentially pollute water channels if not managed properly.

This underlies the needs for proper and integrated waste processing such as wasteprocessing in the campus area to create an alternative source of renewable fuel by utilizing biodrying technology. Moreover, campus is expected to play a role in waste handling and waste reduction efforts launched by the Government of Indonesia towards the program of Indonesia Bersih (Clean Indonesia) 2025 which is committed to set a target of 30% waste reduction and 70% waste handling. In addition, this study is further developed based on the study of [12], through the similar research of biodrying relying on investigating the evolution of temperatures of the bulking agents put in the reactor. However, the prior study used triplex material for the reactor, while this research will develop the reactor made of acrylic prioritizing its transparency property and light transmitting medium [13].

2. Methods

2.1 Sample

The research was carried out in the Waste Transfer Facility, Campus A, Universitas Trisakti, Jakarta. Solid waste was collected from each building in the area of Campus A, Universitas Trisakti which was dominated by organic waste.

2.2 Equipment

This study used an acrylic square reactor with ventilation holes and aeration channels. The reactor was utilized as the medium where the biodrying process occurs. The flow speed usedwas 3 liter/min. The temperature of the compost was measured using a digital thermometer withan accuracy of 0.01. Reactor size as shown in Figure 1. The parameter analyzed in this research is compost temperature. The schemes of this biodrying reactor are:

a. there are six holes in the reactor, three holes for the sample port, one hole for aeration, one for leachate outlet and one in the reactor cover as air vent;
b. each of these holes measures 1/2 inch, 1 inch, 1 inch and 3/4 inch;
c. the aeration holes in the reactor are connected with pipes that are parallel connected from the blower pump. The aeration pump used is an air pump available on the market, with the air discharge rate are 3 l/s;
d. the sampling points consist of 3 (three) holes, the holes are covered with plastic to maintain the temperature of the waste material;
e. the leachate hole serves for leachate water channels produced during the process.

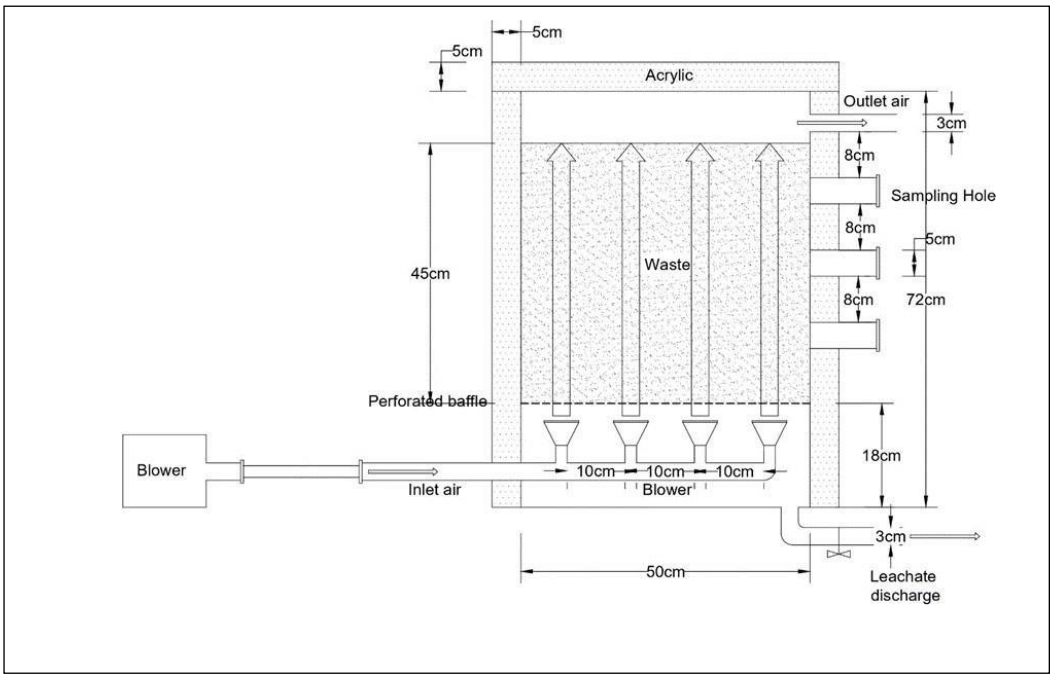


Figure 1. Design of biodrying reactors used with aeration ducts and ventilation pipes

2.3 Analytical method

Parameters to be measured in this study apart from the proximate analysis test component consisting of water content, ash content, volatile content, fixed carbon and calorific value also include RDF (waste) material temperature, air discharge, volume as well as the pH of the leachate which can be seen in Table1.

Table 1. Research parameter

Research parameters	Unit	Standard Method	
RDF material temperature	^{o}C	Measurement with digital thermometer	SNI 6989.23-2005
Leachate pH	-	Measurement with pH meter	SNI 6989.11:2019
Leachate percolation volume	mL	Measurement with lab measuring cup	-
Air flow	L/min	Measurement with *airflow meter*	-

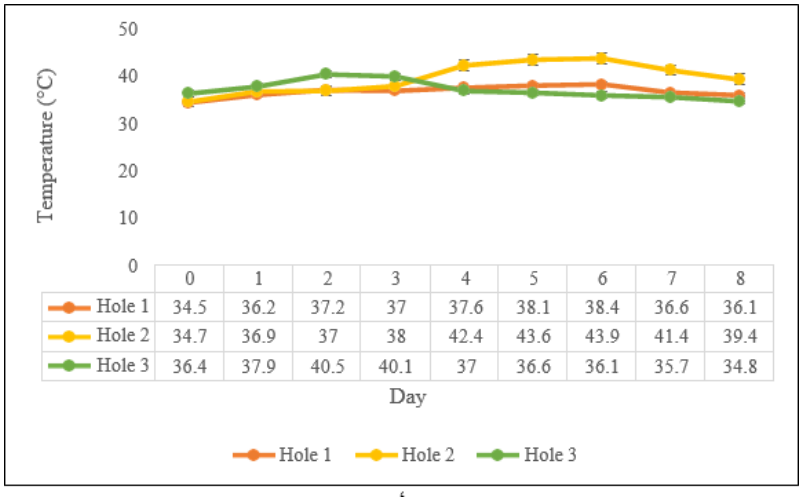
3. Results and discussion

In order to produce the good quality of raw materials for RDF that comply with the requirements of production, a number of previous studies have shown that the air discharge rate has the significant factor, especially having a role as a heat carrier in a controlled environment [4]; [6]. Meanwhile, [7] investigated the effects of three different aerationdischarge rates on cow dung biomass and straw treated in biodrying reactors showing that high aeration discharge rates produce the highest decrease in moisture content, medium aeration discharge rates produce the highest temperature and low aeration discharge rates produce the lowest temperature values. Furthermore, [5] examined the optimal aeration discharge rate based on the classification of oxygen supply through the insulation process in waste biomass, namely aeration with positive and negative operating modes that can determine optimal conditions for temperature, product quality and detention time.

According to [6], during the biodrying method, air discharge is the most important factor that must be controlled since a low aeration discharge rate may result in a decomposition process that is not accompanied by a significant decrease in moisture content, causing the biodrying process may not optimally run. This condition can be assumed to havesimilarity with composting technique, thus several main parameters in the form of physical, chemical and biological characteristics must be ensured to support RDF standards in this biodrying process, such as waste composition, C/N ratio, initial moisture content, pH, void area inside the waste (ratio of void area within waste), temperature, aeration discharge and frequency of stirring waste [6]; [11].

Meanwhile, [1] confirmed that a low aeration discharge rate at high temperature of biodrying may increase the decrease in water vapor content. This happens because a decreasein the rate of aeration discharge may help to collect heat in the reactor system to encourage evaporation of water vapor due to the excess aeration supply to boost the decrease in water vapor through air holes or vents.

The application of biodrying technology in Universitas Trisakti focuses on the changing temperatures produced in the bioreactor to confirm that the decomposition of organic materials was present. Commercial process cycles are completed within 7–15 days, with mostly $H_2O(g)$ and CO_2 loses of ca. 25–30% w/w, leading to moisture contents of <20% w/w. High airflow rate and dehumidifying of re-circulated process air provides for effective drying [10], so the process of biodrying in this study was observed for 8 (eight) days which identified the activities of microorganisms at the third days, revealed by the condensation of the evaporated water released on the top and side walls of the biodrying reactor. This aerobic process was also shown by the increased temperature measured in eachobserved holes (Figure 2). Due to this condition, the designed reactor needs further innovation to avoid the condensation of evaporated water to raise the reduction rate of moisture content. This pretreatment study showed the absence of leachate which proves that the biodrying method has the potential to reduce the negative impact of unmanaged solid waste generation.



	0	1	2	3	4	5	6	7	8
Hole 1	34.5	36.2	37.2	37	37.6	38.1	38.4	36.6	36.1
Hole 2	34.7	36.9	37	38	42.4	43.6	43.9	41.4	39.4
Hole 3	36.4	37.9	40.5	40.1	37	36.6	36.1	35.7	34.8

Figure 2. The increased temperatures during the observed days of biodrying process

The process of drying waste (biodrying) involves the stages of decreasing water content in order to increase the calorific value of the waste. In order to apply for this biodrying technique, the aerobic process plays an important role in removing water content which is usually in the form of water vapor through appropriate aeration techniques and increased temperatures produced by the decomposition of organic materials.

Removal water content measured in each observed holes are 40%, 20%, and 10%. Hole 1 is 40%, located at the top reactor, so the removal water content is greater due to evaporation. The bio-drying process has an impact on the decrease of water content due to high temperature and adequate ventilation. proper aeration control and temperature can lower water levels efficiently (66.7% of the initial moisture

content). Solid waste can be burned properly when the water content is about 20% [12].

The advantage of applying this biodrying method is shown by waste as raw material will have a reduced water content, yet the calorific value of the waste increases [3]. In addition to the biological treatment, the biodrying method also applies mechanical treatment thus biodrying method can be implemented through the concept of a bioconversion reactor with an integrated mechanical biological waste treatment system. In this biodrying reactor, heat energy is released during the process of decomposing organic matters under aerobic conditions along with the supply of aeration to dry the organic waste [10].

4. Conclusion

Municipal solid waste is typically generated from daily human activities, both from domestic and non-domestic activities, included the activities in campus. Solid waste processing technology with the concept of waste to value has been recognized to have the potential to reduce the volume of waste generation The application of biodrying technology in Universitas Trisakti focuses on the changing temperatures produced in the bioreactor to confirm that the decomposition of organic materials was present. The activities of microorganisms at the third days, revealed by the condensation of the evaporated water released on the top and side walls of the biodrying reactor. This aerobic process was also revealed by the increased temperature measured in each observed holes. This pretreatment study showed the absence of leachate which proves that the biodrying method has the potential to reduce the negative impact of unmanaged solid waste generation.

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The Application of Biodrying Method for Organic Waste

by Dewan Riset & Pengabdian kepada Masyarakat

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2. Methods

2.1 Sample

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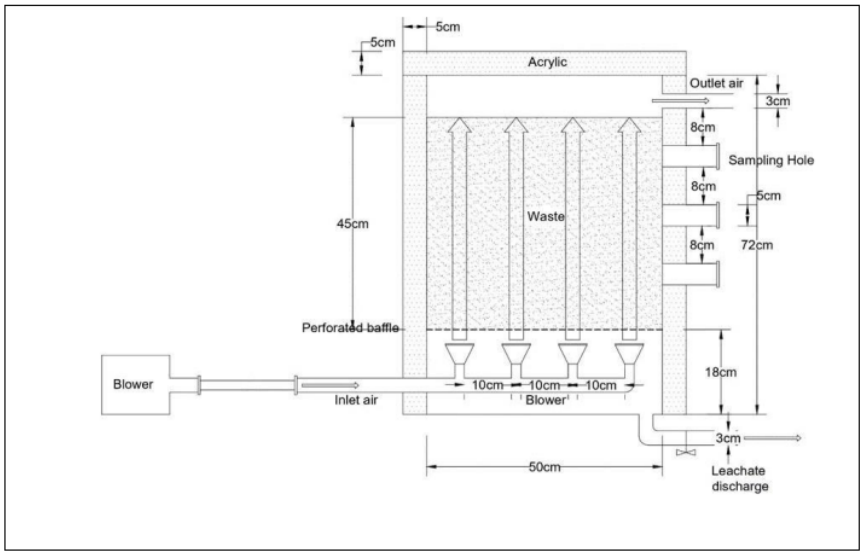

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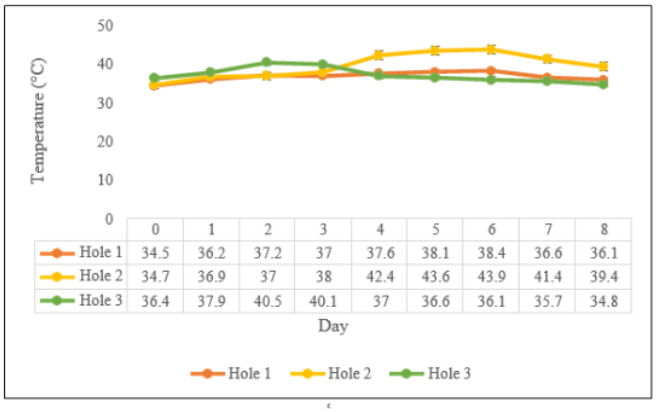

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Removal water content measured in each observed holes are 40%, 20%, and 10%. Hole 1 is 40%, located at the top reactor, so the removal water content is greater due to evaporation. The bio-drying process has an impact on the decrease of water content due to high temperature and adequate ventilation. proper aeration control and temperature can lower water levels efficiently (66.7% of the initial moisture

content). Solid waste can be burned properly when the water content is about 20% [12].

The advantage of applying this biodrying method is shown by waste as raw material will have a reduced water content, yet the calorific value of the waste increases [3]. In addition to the biological treatment, the biodrying method also applies mechanical treatment thus biodrying method can be implemented through the concept of a bioconversion reactor with an integrated mechanical biological waste treatment system. In this biodrying reactor, heat energy is released during the process of decomposing organic matters under aerobic conditions along with the supply of aeration to dry the organic waste [10].

4. Conclusion

Municipal solid waste is typically generated from daily human activities, both from domestic and non-domestic activities, included the activities in campus. Solid waste processing technology with the concept of waste to value has been recognized to have the potential to reduce the volume of waste generation The application of biodrying technology in Universitas Trisakti focuses on the changing temperatures produced in the bioreactor to confirm that the decomposition of organic materials was present. The activities of microorganisms at the third days, revealed by the condensation of the evaporated water released on the top and side walls of the biodrying reactor. This aerobic process was also revealed by the increased temperature measured in each observed holes. This pretreatment study showed the absence of leachate which proves that the biodrying method has the potential to reduce the negative impact of unmanaged solid waste generation.

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