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Investigating the effect of aeration on reducing food moisture by biological drying method

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ABSTRACT: Biological drying is one of the pre-processing methods of waste to reduce its moisture. Municipal waste in developing countries, especially Iran, has high humidity due to separation from the source of dry waste and high volume of organic waste. The high humidity of municipal waste makes it difficult to manage this type of waste, reduce the thermal value, produce leachate and complicate disposal and recycling methods. Biological drying is an automated thermal process in which the rate of drying with the biological heat released during the decomposition of organic matter in situ increases and reduces moisture while retaining calories. Therefore, this method can be used as a method of pre-processing organic waste to produce heat and convert it into a fuel with high calorific value. The aim of this study was to investigate the effect of aeration on reducing the moisture content of food waste by biological drying of perishable organic waste. Hence, a new pilot-scale biological drying system was designed for municipal solid waste processing. Also, important and influential factors on biological drying including mixing rate, moisture, particle size, aeration time, aeration amount and bulking factor were investigated. Finally, the pilot performance on perishable food waste prepared from the central self-service of the main campus of Shahid Beheshti University was evaluated with two aeration rates. The results showed that the weight, volume and moisture content of the waste was significantly reduced and the ph value of the waste leachate was stabilized at 8.35. Moisture is also greatly reduced so that at the end of the first phase is equal to 25.10 and the second phase is equal to 21.80 and volatile solids are increased. The final weight of the waste reached 6.86 kg and as a result, aeration in reducing the moisture content of perishable food waste by biological drying method is a sustainable method to reduce the moisture content of the waste.

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1- Introduction

Currently, urban solid waste management is one of the global problems, the main reason for which is rapid urbanization, followed by the development of industrial construction activities [1]. Waste-to-energy conversion technology has the potential to reduce the volume of primary waste by 90%, depending on the combination with energy recovery [2]. In developing countries, increasing organic waste is one of the most important environmental problems. There are some waste disposal methods, such as incineration, landfill, biogas production, etc., that are efficient but have negative effects on the environment as well as public health. Anaerobic and aerobic decomposition processes lead to changes in carbon quality because digestible carbohydrates are decomposed easier and faster. The aeration method is currently being used in other countries, especially in Germany [3]. The main advantages of this method are the reduction of leachate pollution, mainly in the form of ammonium and chemical oxygen demand, as well as the reduction of methane production potential. Pre-disposal waste processing facilitates and reduces collection and disposal costs. Reducing waste moisture is one of the methods of waste processing to reduce the volume, increase the thermal value, reduce contact with the environment by reducing leachate. Biological drying is an automated thermal process in which the rate of drying with the biological heat released increases during the decomposition of organic matter on site. Therefore, a suitable alternative for waste management is proposed in terms of feasibility and cost. Biological drying reduces moisture while preserving calories [4]. The water content of municipal solid waste is a very important factor that affects the combustion efficiency and hence in the energy conversion processes into waste [5]. Therefore, according to the above and the importance of the effect of aeration in biodying in this article, we will investigate the effect of aeration in reducing the moisture content of food waste by biological drying [6]. Therefore, an innovative pilot-scale biological drying system has been designed for the treatment of municipal solid waste. Zaman et al. [7], in their research on the process of biological drying, found that the heat generated by the process of aerobic decomposition

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of organic compounds with air helps to dispose of waste. The result of processing using bio-drying can be used as waste fuel (RDF) and this fuel is produced from different types of solid waste. RDF can be used as an alternative to coal. From the results of the research, we find that the processing of solid waste using bio-drying technology can be used in the production of renewable energy as waste fuel (RDF), reducing the amount of solid waste water, improving the quality and Increasing the amount of recycled solid waste is beneficial [7]. The aim of this study was to investigate the performance of the biological drying process in reducing the moisture content of food waste and the effect of aeration rate on accelerating the drying process.

2- Methodology

In the design and construction of a laboratory pilot, two pilot devices were used to process perishable organic waste for biological drying. To make the main body of the pilot, PVC sheets with resistant high-glass color coating have been used, which is an important reason for choosing this material. And lack of permeability in the face of moisture and leachate is produced by waste. Since the use of biological method only for waste processing is very time-consuming and practically somewhat uneconomical, in the design and construction of the laboratory pilot, the mechanical method has been used to some extent, and in this particular case, the air blower known as tail has been used. The most important advantage is the simplicity of the internal mechanism, availability and low energy consumption.

2- 1- Residual moisture content

To determine the percentage of moisture, the oven drying method was used, which is much more accurate than other methods and is also a step of preparing the samples for further analysis.

2- 2- Electrical conductivity

Electrical conductivity shows the ability of a sample to conduct electricity as a number. In this experiment, 10 g of the sample is mixed with 90 cc of distilled water and mixed for 30 minutes, the samples are filtered and after 10 minutes, the EC level was measured by a digital meter.

2- 3- The amount of ash and volatile solids

Place the empty container in the oven at 550 °C for 15 minutes and after cooling 2 g of the dried sample at 550 ° C for 2 hours in the oven at 550 ° C. Finally, the sample was cooled in a desiccator and weighed with a precision scale of one-tenth of a milligram.

2- 4- pH value

First, mix one part of the sample with 5 parts of distilled water (50 g of sample in 250 cc of distilled water) for 45 minutes using a mixer, and after 10 minutes, read the pH value using a pH meter.

2- 5- Total organic carbon

TOC samples were measured by TOC analyzer based on NPOC (Non-Purgeable Organic Carbon) program. For the design of experiments for waste processing by biological drying method, important and influential factors should be considered with determining variables, including these factors and key variables can be the amount of mixing, humidity, particle size, aeration time, aeration amount, factor Bulky and pointed out. Due to the importance of the above, two steps were taken to cover all of the above, which include the following steps:

The first and second stages were carried out with perishable food waste prepared from the central self-service of the main campus of Shahid Beheshti University (no decomposable materials by separation) and with different amounts of aeration in two separate devices (pilot), as well as the weight of food waste Used as follows:

The weight of the waste used is gross 45 kg, which after separating the indivisible part by 8.50 kg, its net weight reaches 36.250 kg.

3- Results and Discussion

The purpose of this experiment was to investigate the effect of aeration on reducing the moisture content of food waste for biological drying of perishable food waste (no biodegradable material by separation) and with different amounts of aeration in two separate devices (pilot) that Done on different days. In this stage, the experiments performed include two stages (first stage: with four aeration cavities of 4 millibars per second, second stage: with two aeration cavities of 3 millibars per second) with a type of waste, the results of which Are analyzed in detail in each basket by providing outputs related to the measured parameters in each experiment. In this experiment, the optimal rate has been determined according to the blower power. It should be noted that this rate varies in different types of blowers. The experiment was performed for 41 days in the central greenhouse of Shahid Beheshti University. The pilot environment is completely isolated during aeration and no air entry and exit have taken place during the process. The aeration rate is set by the board connected to the device. Aeration in this experiment was performed based on previous studies for 15 minutes every 2 hours. The parameters for this experiment were reactor temperature, ambient temperature and residual humidity, which were measured daily. Finally, the weight of the residual waste at the end of the period (last day) was significantly reduced and the total of two devices reached 6.860 kg.

4- Conclusion

Biological drying is an automated thermal process in which the rate of drying with the biological heat released increases during the decomposition of organic matter on site. Therefore, it offers an interesting alternative to waste management in terms of feasibility and cost. Biological drying reduces moisture while preserving calories. The use of biological drying is a good method for the treatment of very wet waste, which releases a large amount of leachate if the

waste is burned directly and without any processing. Also, the water content of municipal solid waste is a very important factor that affects the combustion efficiency and, therefore the energy conversion processes into waste. The aim of this study was to investigate the effect of aeration in reducing the moisture content of food waste by biological drying of waste food from perishable food waste. Therefore, an innovative pilot-scale biodegradation system has been designed for the treatment of municipal solid waste and considers important and influential factors with determining variables including mixing rate, humidity, particle size, aeration time, aeration amount and bulk factor. , And due to the importance of the above, two steps have been taken to cover a significant part of the above. The obtained data showed that in the first and second stages, EC decreased with time also after the cycle in the first stage, the existing waste lost its moisture and the most significant changes were observed from the nineteenth day onwards. At the end of the period is equal to 25.10 and in the second stage, the existing waste loses its moisture relatively and the most significant changes are observed on the twenty-sixth day and after the end of the period is equal to 21.80 that the stage Second, compared to the first stage, the percentage of moisture decreases and the amount of volatile solids increases, and the reason is the different amount of aeration in the two pilots. The results showed that the weight, volume and moisture content of the residue decreased as well as the pH of the leachate (8.35) of the residue stabilized and largely removed and remained at 30-40CC and the volatile solids (VS) were constant. The final weight of the waste is equal to 6.860 kg. Therefore, aeration in reducing the moisture content of perishable food waste by biological drying method is a sustainable method to reduce the moisture content of the waste

References

[1] A.P. Tom, R. Pawels, A. Haridas, Biodrying process: A sustainable technology for treatment of municipal solid waste with high moisture content, Waste management, 49 (2016) 64-72.

[2] M. Atauzzaman, Q. Bari, Effect of passive and forced aeration on composting of market solid waste, International Journal of Engineering & Technology, 9(1) (2020) 182-186.

[3] L. Liu, J. Ma, Q. Xue, J. Shao, Y. Chen, G. Zeng, The in situ aeration in an old landfill in China: Multi-wells optimization method and application, Waste Management, 76 (2018) 614-620.

[4] C. Brandstätter, R. Prantl, J. Fellner, Performance assessment of landfill in-situ aeration–A case study, Waste Management, 101 (2020) 231-240.

[5] C. Scheutz, R.B. Pedersen, P.H. Petersen, J.H.B. Jørgensen, I.M.B. Ucendo, J.G. Mønster, J. Samuelsson, P. Kjeldsen, Mitigation of methane emission from an old unlined landfill in Klintholm, Denmark using a passive biocover system, Waste management, 34(7) (2014) 1179-1190.

[6] K. Suksankraisorn, S. Patumsawad, B. Fungtammasan, Co-firing of Thai lignite and municipal solid waste (MSW) in a fluidised bed: Effect of MSW moisture content, Applied Thermal Engineering, 30(17-18) (2010) 2693-2697.

[7] B. Zaman, W. Oktiawan, M. Hadiwidodo, E. Sutrisno, I.W. Wardana, Potential application of biodrying to treat solid waste, in: E3S Web of Conferences, EDP Sciences, 2018, pp. 03013.

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