

EFFECT OF DIFFERENT AERATION RATES ON THE BIODRYING OF BIOGAS RESIDUE WITH HIGH MOISTURE CONTENT

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INTRODUCTION

Anaerobic digestion is widely used in the treatment of agricultural and municipal waste, and it is regarded as a cost-effective and efficient method of dealing with organic solid waste (Ren et al., 2018; Ma et al., 2020). However, it generates a large quantity of residue, which has a negative impact on the environment. The high moisture content of waste (74%-90%), bad odour, pathogens, plant toxins, and high quantities of heavy metals all constitute a significant environmental burden (Ma et al., 2021; Bai et al., 2020). As a result, resource utilization and reduction of biogas residue must be realized.

Biodrying is an energy-saving approach for successfully recovering organic solid waste with a high moisture content (Hao et al., 2018). However, the use of BR, particularly BR with a high moisture content, as a raw material for biodrying has received little attention. Moisture content is a key metric for assessing the effectiveness of biodrying, and the degree of maturation assures that biodrying products are nontoxic and helpful. As a result, the current study concentrated on biodrying performance and maturation impact, and investigated the effect of varied aeration rates on biodrying and maturity of BR with a high moisture content.

MATERIALS AND METHODS

In this investigation, BR with a high moisture of 91.1% was collected from the Dongcun Comprehensive Garbage Treatment Plant in Beijing, which used wet anaerobic technique to handle food waste. All of the reactors were laboratory-scale and self-designed. Pump, gas flowmeter (LZB-3,0.1-1.0L/min), biodrying reactor, and gas absorption bottle were all incorporated in the system. The aeration rate was 0.6、0.8、1.0、1.2、1.5 L/min•kg for the T1、T2、T3、T4、T5 names, respectively. The auxiliary heat temperature was kept at 50°C, and the stack rotating operation was done at the same time every day. Dates of sampling: 0, 2, 4, 5, 6, 7, 8, 9, 10, 11, 12.

RESULT AND DISCUSSION

(1) Biodrying performance

Water regulates the temperature, dissolves organic matter, and aids in microbial metabolism. As a result,

water content has a significant impact on biodrying and is one of the key indicators for assessing drying effect (Mohammed et al., 2017). The change in the moisture content of BR during biodrying was shown in Fig.1.

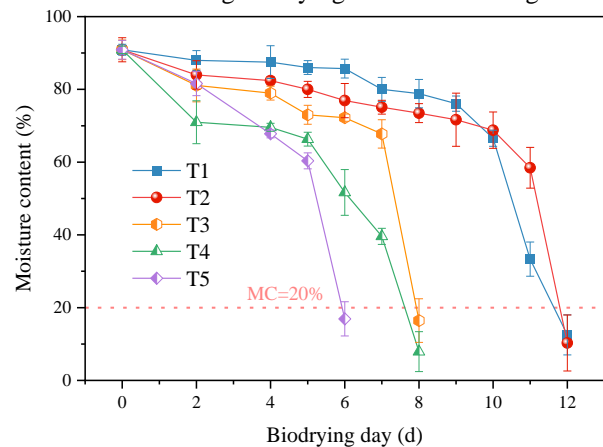


Figure 1. Changes in water content of different samples. Aeration not only supplied the oxygen needed for microbial activity, but it also removed water from the biogas residue in time. As shown in Fig.1, the aeration greater, the rate of water content reduction turned quicker, and the reduction tended to be gradual at first, then fast. The biodrying process took 12 days when the aeration rate was 0.6 and 0.8 L/min•kg. The biodrying process took 8 days when the aeration rate was raised to 1.0 and 1.2 L/min•kg. When the aeration rate raised to 1.5 L/min•kg, the water content of BR reduced to less than 20% in only 6 days.

(2) Evaluation of germination index and pH

The germination index (GI) was used to determine if the dried product could be utilized as organic fertilizer for agriculture by evaluating the degradation and phytotoxicity of hazardous chemicals (Li et al., 2020). Material with a GI of 70% or greater was thought to be highly degraded and non-toxic to plant germination and growth. With an initial GI value of 14.7%, it was discovered that BR exhibited considerable phytotoxicity (Fig. 2) and was thus unsuitable for direct agricultural and non-agricultural uses. The GI of the T1 and T2 groups grew slowly at initially and significantly after day 9 of the drying experiment, as shown in Fig. 2. The GI of group T1 reached a maximum on day 12 (105.8%).

The group T2 had a GI of over 70% on day 9, meeting the standard set by NY525-2021 of China, and a maximum GI on day 11 (107.3%). However, groups T3, T4 and T5 had a GI below 40% and were toxic to plants and did not meet the criteria for decomposition.

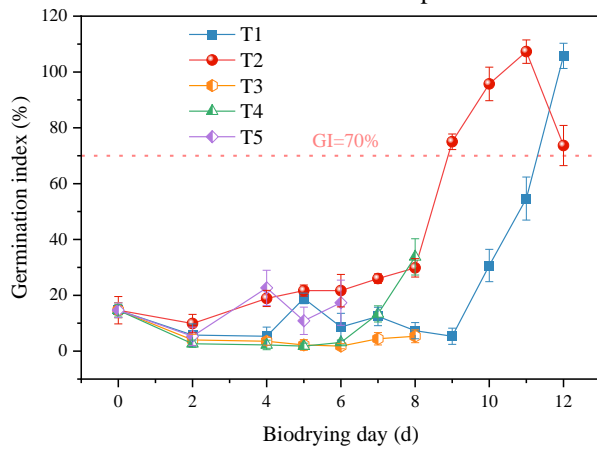


Figure 2. Dynamic changes in GI.

pH was a crucial element influencing microorganism development. It influenced not just mineral dissolution but also the level of microbial activity (Bai et al., 2020). Because bacterial metabolism decreased the pH of organic waste, pH may be used to indicate bacterial activity.

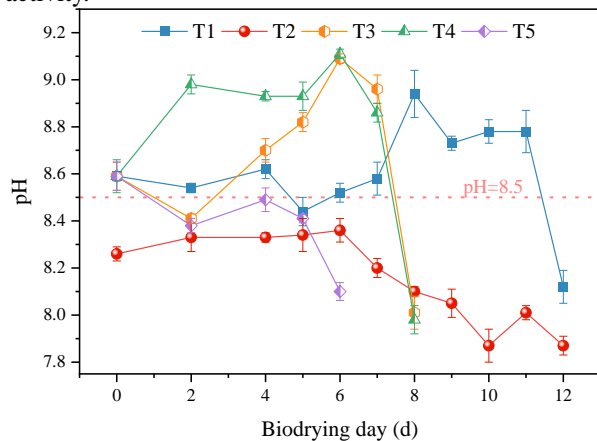


Figure 3. Dynamic changes in pH.

The pH of all the groups showed an overall trend of firstly increasing and then decreasing. The increase in pH may be related to the degradation of protein followed by the generation of ammonia gas with the increase in temperature at the initial stage of biodrying. Except for T2, the pH values of all the groups did not meet the standard of pH 5.5–8.5 stipulated in NY 525-2021, China. High pH, which was not conducive to plant growth, could potentially be the cause of low GI.

CONCLUSION

The aim of this study was to investigate the optimum aeration rate for the BR with high moisture content in biodrying process. An aeration rate of 0.8 L/min·kg resulted in a product with a high GI value and stable pH.

This study provided a new solution for the treatment and disposal of high water content BR.

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