

論文 / 著書情報
Article / Book Information

題目(和文)	
Title(English)	Effect of Different Aeration Method on Organic Matter Degradation during Composting
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出典(和文)	学位:博士(工学), 学位授与機関:東京工業大学, 報告番号:甲第11629号, 授与年月日:2020年9月25日, 学位の種別:課程博士, 審査員:中崎 清彦,竹下 健二,江頭 竜一,吉村 千洋,小山 光彦,戸田 龍樹
Citation(English)	Degree:Doctor (Engineering), Conferring organization: Tokyo Institute of Technology, Report number:甲第11629号, Conferred date:2020/9/25, Degree Type:Course doctor, Examiner:,,,,,
学位種別(和文)	博士論文
Category(English)	Doctoral Thesis
種別(和文)	論文要旨
Type(English)	Summary

論文要旨

THESIS SUMMARY

系・コース： 融合理工学 系
Department of Graduate major in • 地球環境共創 コース
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申請学位 (専攻分野)： 博士 (Engineering)
Academic Degree Requested Doctor of
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要旨 (英文 800 語程度)

Thesis Summary (approx.800 English Words)

Composting is a degradation process of organic matter (OM) to a stable final product by a diverse aerobic microbial community. Thus, maintaining a proper aerobic condition is become essential during composting. To prevent the anaerobic condition in the heap, installation of aeration is commonly used in the composting facility.

Sufficient oxygen is important for the growth and metabolism of aerobic microorganisms in the composting. Thus, in order to successfully progress the organic matter degradation, appropriate aeration is important to maintain aerobic condition during composting. There are two types of composting aeration namely as (1) positive aeration (PA) or (blow type) and (2) negative aeration (NA) (suction type). In PA, the air flows from the bottom to the top of the compost is the common aeration method, but this aeration system diffuses the foul odor to the atmosphere due to ammonia produced. By contrast, in NA, the air flows from top to bottom of the compost can reduce ammonia gas diffusion because it could be easily collected at the bottom composting pile. But NA system has been scarcely applied probably due to the complexity of process management and the effect of aeration methods to the organic matter degradation still unclear. Among the various parameters which governs the organic matter degradation during composting, different air flow direction between PA and NA should influences the system performance. The differences in air flow direction between PA and NA could affect to the physical-chemical parameters such as ammonia accumulation, heat and temperature distribution of composting. Which later could influence the change of microbial community, catabolic function and the activity, which could result in the change of the organic matter degradation. But the effect of different of aeration types on composting still not been clarified.

Therefore, the primary goal of this study is to clarify the effect of different aeration types on OM degradation during composting. The study is elaborated into three parts. The first part investigated the effect ammonia adsorption on composting, in here to simulate the temperature distribution in a lab-scale composting reactor system, the composting was conducted in a temperature-controlled environment. It has been reported that higher composting temperature results in higher ammonia gas volatilization from the compost. Thus, the ammonia retention in the compost could be different depending on the temperature distribution and the air flow direction, which could influence the microbial activity during composting. The hypothesis for this part is, the high amount of ammonia absorption in the low temperature composting heap would damage the microorganisms, which result in the disruption of OM degradation. The results show that PA system has higher concentration of ammonium ion because of the water condensation in the mesophilic layer of composting. Interestingly, it was also found that composting microorganisms did not deteriorate by the NH_3 absorption. Hence, the OM decomposition rate was similar between PA and NA system.

Though, in the controlled condition, the OM degradation rate was similar between PA and NA systems. However, the self-heating condition could influence the temperature profile and pH which affect to the OM degradation rate. Hence, the effect of aeration types towards OM degradation rate on large scale composting should be investigated. In the second part, the effect of different aeration types on large-scale composting was observed in the 200 L cylindrical drum reactor which operated under self-heating condition. It was found that, the OM degradation of PA was faster compare to the NA systems, due to the higher heat retention in PA system. The higher temperature in PA system can be attributed to the lower latent heat loss in PA as compared to that in NA. The temperature differences between PA and NA systems, probably influenced the microbial community and their catabolite function during composting.

In the third part, to understand the mechanism of the acceleration of OM degradation rate in PA compare to NA systems (from the second part results), the change of the microbial community, catabolite function, and/or activity during the composting need to be clarified. The microbial community involved in the degradation of easily degradable (ED) material was found to be similar between in PA and NA systems, despite different temperature profile and OM degradation rate. The functional gene prediction analysis by PICRUSt2 showed that the protease gene abundance was similar between different aeration systems, indicating that the enzyme activity did not influence the microbial community nor their catabolic function. Faster OM degradation rate in PA resulted in the early proliferation of *Thermobifida* and played a key role in the degradation of relatively hardly degradation (RHD) material (cellulose).

This study is the first study which clarified the organic matter degradation rate was different between PA and NA. Hence, the recommendation for this present study is both of aeration types could be applied in the composting field which depending to the priority. In case odor issue is not problematic (e.g. the composting facility is located in rural area), PA system is advantageous since this system has faster organic matter degradation rate. In case odor issue should be concerned (e.g. the composting facility is located in urban area), NA system is applicable to minimize the odor emission while organic matter degradation rate is sacrificed in some extent.

備考：論文要旨は、和文 2000 字と英文 300 語を 1 部ずつ提出するか、もしくは英文 800 語を 1 部提出してください。

Note：Thesis Summary should be submitted in either a copy of 2000 Japanese Characters and 300 Words (English) or 1copy of 800 Words (English).

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