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THE OUTLINE OF DISSERTATION

Title: Effect of Different Aeration Method on Organic Matter Degradation during Composting

CHAPTER 1: Introduction

This chapter presents a statement regarding the concerns on the increase of solid waste production as the sequence of the rapid increment of human population. Composting is introduced as the alternative solution to manage this global solid waste problem. A brief introduction about the different aeration types (positive aeration (blow type, PA) and negative aeration, (suction type, NA)) and the problem statement about unclarified organic matter (OM) degradation rate between both aeration types are described. The difference of the air flow direction could influence organic matter degradation by changing ammonia accumulation, temperature distribution and microbial community/activity/function, but the effect of aeration type on it has not been clarified yet. The primary goal of this study is to clarify the effect of different aeration types on OM degradation during composting

CHAPTER 2: Effect of ammonia on temperature-distributed composting in the small-scale composting reactor

In this chapter, the effect of ammonia accumulation on temperature-distributed composting was investigated by using the small-scale composting reactor consisted of two lab-scale reactors and connected in series (upper and lower reactors). By using the small-scale reactor, the temperature condition of composting could be controlled. Hence, both aeration types (PA and NA) of composting can be simulated. Furthermore, the effect of

turning and static condition on different of temperature distribution and ammonia absorption of composting were also investigated. It was expected that the static conditions to have larger differences physicochemical parameters (including NH_4^+ accumulation) compare to turning condition, since in static condition the upper and lower reactor were not mixed. Hence, it was hypothesized that higher ammonia accumulation in static will more disrupt the composting microorganisms compare to the turning condition. 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, regardless in turning or static condition.

CHAPTER 3: Effect of aeration method on organic matter degradation in the self-heated large-scale composting reactor

This chapter intended to investigate the effect of different aeration types on organic matter degradation rate on composting by using large-scale reactor (200 L cylindrical drum). The investigation was conducted in the self-heating condition. The composting speed between PA and NA systems was expected to be different due to different in the temperature distributions between both aerations. The conversion of carbon (organic matter degradation) was measured by the re-composting of compost sample which withdrawn from large-scale composting with the use of lab-scale reactor system. It was found that the organic matter degradation of PA was similar with NA at the end of composting (25 days). However, the composting speed of PA system was faster compare to the NA system. This is probably

attributed to lower latent heat loss in PA compare to NA and resulted higher temperature region in PA. The temperature differences between PA and NA systems, probably influenced the microbial community and their catabolic function during composting.

CHAPTER 4: Effect of aeration method on microbial community and their catabolic function during composting

This chapter focused to investigate the effect of different aeration types on microbial community/activity, their catabolic function. The observation was conducted by analyses the result/output from Next Generation Sequencing (NGS) and phylogenetic investigation of communities by reconstruction of unobserved states (PICRUSt2). The key function gene predicted by PICRUSt2 revealed that the protease gene abundance was not much different between PA and NA, indicating that the higher temperature could enhanced the enzymatic activity but did not influence the microbial community nor their catabolic function. Furthermore, faster organic matter degradation in PA resulted in the early proliferation of *Thermobifida* which played a role in degrading relatively hardly degradable (RHD) material by hydrolysis of cellulose into cellobiose.

CHAPTER 5: General conclusions

With the results obtained from chapter 2, 3 and 4 the general conclusion associated with the effect of different aeration types on composting were presented. Furthermore, the application of different aeration types of composting in appropriate condition were also recommended in this chapter.