

Simulation Experiment Study on Biological filter Removal Ammonia Odor During Composting

Xinwei Zhao^{1, a}

¹Art and Design College, YanShan University, Qinhuangdao 066000, China

^a604325413@qq.com

Abstract: Biofilter in biological deodorization can effectively remove the odor generated by composting, but different filler of the biological filter on the treatment effect of odor is different. In the study, the gas produced by the compost was respectively passed through the biofilter with zeolite or a mixture of zeolite and composting solids, and the change trend of ammonia removal rate is basically the same. When the ammonia concentration reaches 4000 mg/m³, after treatment with A, B biofilter, ammonia removal rate is less than 90% ,can not meet the standard; when the ammonia concentration between 200~500 mg/m³, after treatment with A, B biofilter, removal rate reaches 98%, which can reach the three-level factory standard value(GB 14554-93); when the ammonia concentration between 100~200 mg/ m³, removal rate can up to 99%, which can reach the secondary standard; when the ammonia concentration is less than 100 mg/m³, removal rate can up to 100%, which can reach the level one.

1. Introduction

With the increase of urban garden greening area, garden waste production is also increasing. Narrowly garden waste refers to the urban garden, park, and green belt produced waste that mainly from the garden and green belt litter, trees and grassland trimming, wetland harvest of aquatic plants etc. It has a large amount of waste production (about 12% of municipal solid waste), higher pollution load, relative concentration of waste production and the characteristics of slow degradation. But from the waste composition and nature of view, garden waste mainly contains protein, cellulose, fat, and calcium, iron, copper, zinc, cobalt, phosphorus, manganese and other trace elements, which has a good recycling value. Broad garden waste not only includes the above green waste, but also includes waste from the sewage system in the garden such as septic tanks in the garden and so on. Aerobic composting of green waste and septic tank night soil is an important means to achieve garden waste of resources ^[1,2], but it will produce ammonia, hydrogen sulfide, methyl mercaptan and other odor gas during the composting process ^[3]. Not only will cause composting nitrogen loss, pollution of the atmosphere, endanger human and animal health, corrosion equipment, but also cause acid rain hazards and water eutrophication. Therefore, we must adopt effective treatment methods to eliminate odor.

Commonly used methods for dealing with malodorous gases are absorption, adsorption, oxidation, masking, dilution and diffusion, filtration, etc. Emerging biological deodorization method is suitable for the removal of odor from compost due to low investment, low operating costs, simple technology and convenient promotion. Biological deodorization method commonly use biological filter and biological drip filter. The biofilters are usually made of soil, peat ^[4], compost^[5], sawdust, shrubs and other organic matter as carrier; Bio-trickle filters are usually made of synthetic materials or inert materials such as plastic rings, open cell foams, lava, zeolites, glass fiber reinforced plastic ^[6], ceramic materials ^[7], slag, carbon fibers and activated carbon ^[8]. Most of these materials are occupied area,



water retention is not strong, pH buffer performance is small, not suitable for a large number of microbial organisms, not commercial and other shortcomings. So the use of a variety of packing compound to enhance the treatment effect became an important direction in the future research.

Lu Riming^[9] used composting chicken manure compost with bark, wood chips, peat, ceramsite and charcoal mixed with 1: 1 (V: V) to make biofilter filler and compared the effect of biofilter with different packing materials on the removal efficiency of chicken manure compost odor. The results show that biofilter consist of compost and bark has stronger ammonia removal capacity than other fillers. This experiment uses zeolite, as well as zeolite and garden waste composting mixture as filler and compares the effect of biofilter with different packing composition on the removal of feces and leaves compost.

2. Materials and Methods

The flow chart of the test device is shown in figure 1. In this study, the composting experiment of leaves and feces with different ventilation methods was carried out, The gas produced by three composting units of 100 L was collected by air pump and introduced into parallel biofilters A and B with the same flow rate of 160 L / h.

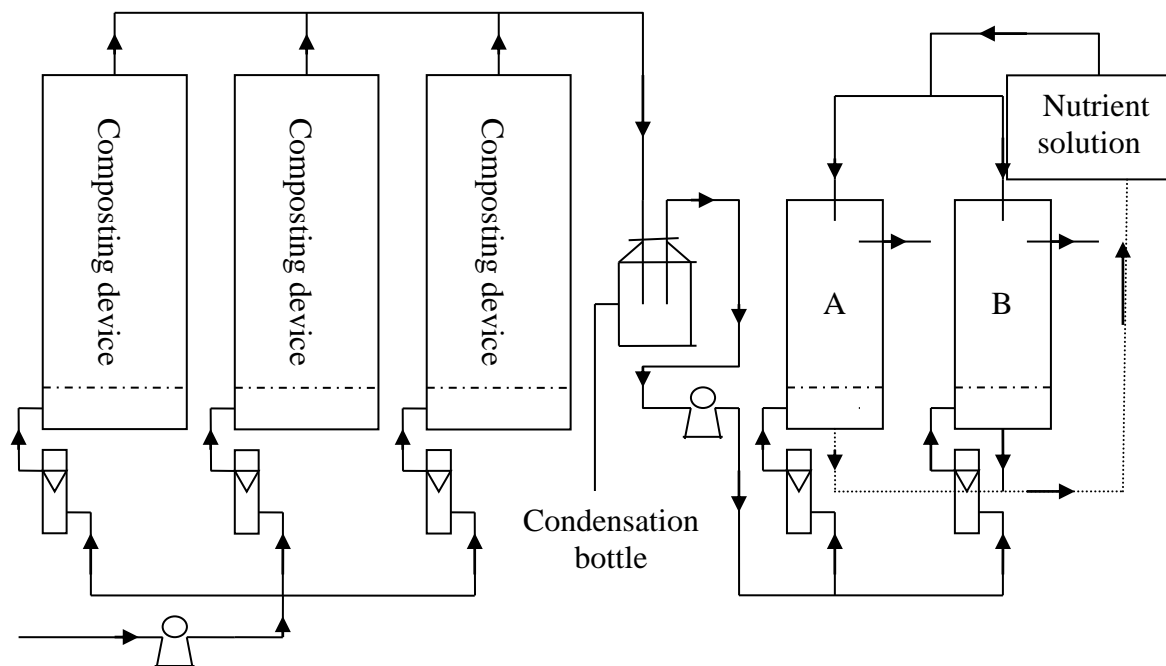


Fig. 1 Schematic diagram of biofilter deodorization system

Biofilters A and B are cylindrical, diameter 0.2 m, height 0.5 m, volume 15 L. A column packed with filler zeolite (particle size 4 ~ 6 mm), The filling mass is about 13.5 kg and the volume is 12.8 L; B column filled with zeolite and composted waste mixture, the volume ratio of 1: 1 mixed filter, The filling mass is about 10.5 kg and the volume is 13.3 L. During the course of the experiment, the nutrient solution was added to the biofilter for 10 min and the flow rate was 550 L / h everyday, Nutrient solution using EM compound bacteria liquid, Diluted by 1:60. The biofilter was incubated for 20 days before this experiment. The ambient temperature during the test is 10 ° C to 18 ° C.

3. Results and Analysis

3.1 The change of ammonia concentration

As can be seen from Figure 2, A and B two biofilters' discharging ammonia concentration trend is basically the same, all with the intake air concentration rise and fall.

In the composting process, when the ammonia concentration is higher than 500 mg/m^3 , after treatment with A, B biofilter, Ammonia concentration basically below 4 mg/m^3 , can reach the three-level factory standard value (GB 14554-93); when the ammonia concentration is less than 200 mg/m^3 , excluded ammonia concentration basically below 1.5 mg/m^3 , can reach the second standard; when the ammonia concentration is less than 100 mg/m^3 , excluded ammonia concentration basically below 1.0 mg/m^3 , can reach first standard.

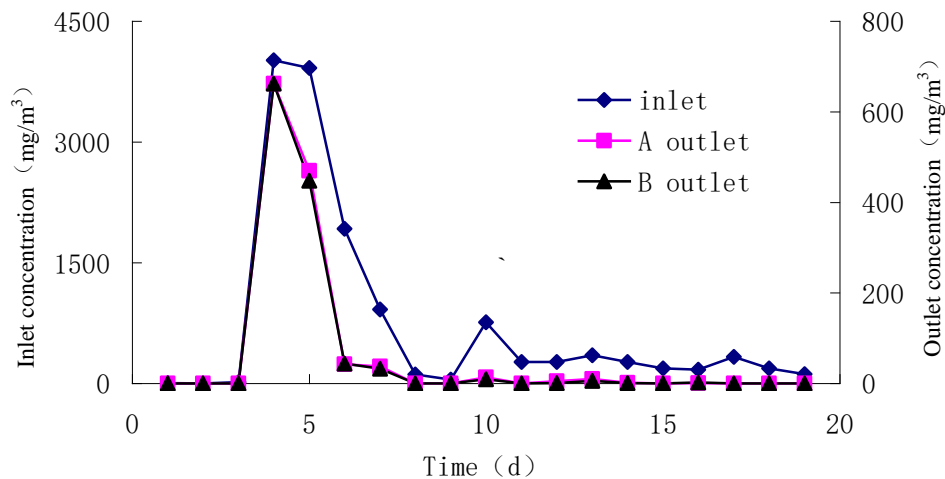


Fig. 2 Changes of ammonia concentration

3.2 The change of Ammonia removal rate

As can be seen from Figure 3. The trend of A and B two biological filters' ammonia gas removal rate is basically the same. In the composting process, when the ammonia concentration reaches 4000 mg/m^3 , after treatment with A, B biofilter, ammonia removal rate is less than 90%; when the ammonia concentration is less than 500 mg/m^3 , after treatment with A, B biofilter, removal rate can up to 98%; when the ammonia concentration is less than 200 mg/m^3 , removal rate can up to 99%; when the ammonia concentration is less than 100 mg/m^3 , removal rate can up to 100%.

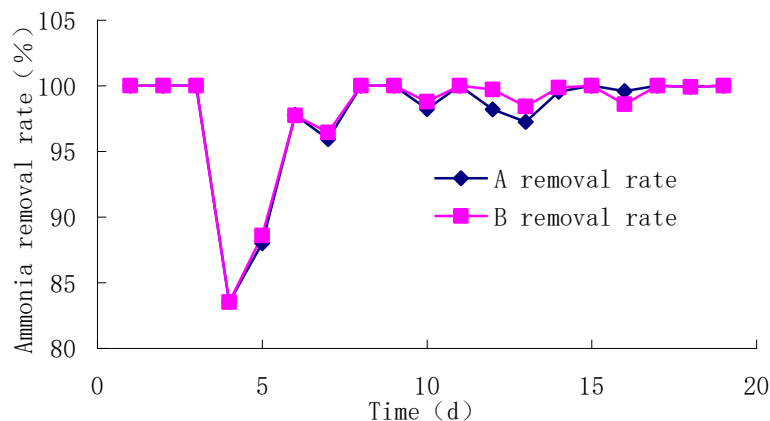


Fig. 3 Changes of ammonia removal rate

4. Conclusions

The biofilter with zeolite or mixture of zeolite and compost as filter, most of the time ammonia

produced can be better to remove during the composting process, so that discharge standards (GB 14554-93). But in the high temperature period of composting, as the ammonia concentration is too high (more than 500 mg/m³), simply use biological filter to remove ammonia can not meet the standard.

References

- [1] X.J. Sun, H.T. Wang, W.J. Lu. Transactions of the CSAE, 25(2009)249-253. (In Chinese)
- [2] L. Liu, T.B. Chen, G.D. Zheng, et al. China Water & Wastewater, 26(2010)120-124.
- [3] YIN Jun, FANG Shi, CHEN Yingxu. Experimental study on the treatment of odor gas containing hydrogen sulfide by peat biofilter[J]. Journal of Environmental Science, 2003, 23(1): 39-42. (In Chinese)
- [4] YIN Jun, FANG Shi, CHEN Yingxu. Biofilters treat low-concentration H₂S and NH₃ mixtures. China Water & Wastewater, 2003, 19(13): 114-116 (In Chinese)
- [5] WANG Ai-jie, XU Xiao-wen, REN Nan-qi, et al. Efficiency of improved bio-trickling reactor for hydrogen sulfide and ammonia removal. Journal of Harbin Institute of Technology. 2008, 40(2): 203-206 (In Chinese)
- [6] Wu Zhichao, Li Guojian, Ma Xiaowei. Preliminary Study on Biological Treatment of Odor. Chongqing Environmental Science, 1994 (4): 26-29. (In Chinese)
- [7] Xu Guiqin, Zhang Jie, Jiang Anxi. Effect of odor removal by immobilized engineering bacteria biofilter. Journal of Natural Science of Heilongjiang University. 2007, 24 (4): 427-429. (In Chinese)
- [8] Jiang Anxi, Zhao Yuxin, Xu Guiqin. Evaluation of air biofilter for H₂S and NH₃ biodegradation. Journal of Natural Science of Heilongjiang University. 2003, 20(1): 92-95 (In Chinese)
- [9] LU Ri-ming, WANG De-han, XIANG Qian-bin, CHEN Guang-yin. Impact of Media Assemblage on the Odor Removal Effects of Biofilter. Journal of Agro-Environment Science. 2007, 26(3): 1164-1168. (In Chinese)