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Influence of palygorskite addition on biosolids composting process enhancement

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ABSTRACT

Mineral addition is considered to be one of the effective methods for the organic waste composting management. The aim of this study was to investigate the potential effect of palygorskite addition on the composting treatment of biosolids. Four dosages of palygorskite (0, 2, 5, and 10%, by dry weight) were added to a mixture of biosolids and sawdust and aerobically composted for 52 days on a pilot scale. The results showed that the addition of palygorskite extended the duration of the thermophilic phase, reduced salinity, and promoted detoxification of the compost. Moreover, the addition of palygorskite accelerated the decomposition of organic matter, reduced the volatilization of ammonia, and increased the total Kjeldahl nitrogen content. Treatment with 2, 5, and 10% palygorskite had a positive effect, reducing peak gaseous emissions by 51.24%, 67.54%, and 73.76% for CH_4, and by 34.50%, 47.34%, and 53.32% for N_2O, respectively. Additionally, the addition of palygorskite reduced the contents of DTPA-extractable Cu, Zn, Pb, and Cd in the compost, and enhanced the degradation of estrogen during composting. The results suggest that a proportion of 2% palygorskite is recommended for biosolids composting, and employing the palygorskite additive in biosolids composting has great potential on resource and nutrient recycling.

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1. Introduction

The organic solid waste materials produced during wastewater treatment are referred to collectively as biosolids. Biosolids contain many unwanted chemical contaminants (heavy metals and pharmaceuticals) and hazardous pathogens (Kinney et al., 2007). At present, with the continuing urbanization and industrialization, more than 6.25 Mt of dry biosolids are produced from wastewater treatment plants in China annually (Yang et al., 2015). The huge amount of biosolids produced requires not only a large amount of land for disposal but also poses an environmental threat (Kacprzak et al., 2017). Consequently, the disposal of biosolids is becoming increasingly important in China in order to meet environmental protection requirements (Xu et al., 2014).

Numerous traditional approaches such as thermal disposal (Li et al., 2018a), aerobic composting (Awasthi et al., 2016), and anaerobic digestion (Xu et al., 2014) have been successfully applied in the treatment of biosolids. Composting is a suitable method in terms of resource cycling utilization, which can reduce both the economic and environmental burden of biosolids, convert organic waste into valuable fertilizer and also reduce the pollution from biosolids discharge (Wong et al., 2009). However, the windrow and pile composting processes often generate malodorous gases and greenhouse gas emissions due to the faster degradation of organic substances (Zhang et al., 2016). These undesired gases may accelerate global warming, be unpleasant to nearby inhabitants, and reduce the acceptability of composting technology in practice (Awasthi et al., 2016). Additionally, the relatively high bioavailability of the heavy metals in the compost feedstock possibly limits the feasibility of utilizing the resulting organic fertilizer (final product of composting) in agricultural applications (Huang et al., 2011). Therefore, finding an effective way to promote the decomposition of biosolids, facilitate the detoxification of contaminants, and improve the quality of the final products is a critical concern for composting technology development (Li et al., 2012).

Recently, many efforts have been devoted to promote the

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