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Evolution of process parameters and determination of kinetics for co-composting of organic fraction of municipal solid waste with poultry manure

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HIGHLIGHTS

- Seven process parameters were monitored in co-composting of OFMSW and poultry manure.
- The mixture of 60% OFMSW/20% manure/10% compost/10% sawdust gave the highest OM degradation.
- Nine kinetic models were analyzed with four statistical indicators.
- Satisfactory fitting of proposed kinetic model to the experimental data of OM was achieved.
- The number of measured variables influences kinetics more than the number of kinetic parameters.

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ABSTRACT

This study aimed to monitor the process parameters and to determine kinetics in composting of organic fraction of municipal solid waste (OFMSW) and poultry manure. The experiments were carried out with three different mixtures. The results showed that the mixture 60% OFMSW, 20% poultry manure, 10% mature compost and 10% sawdust provided the most appropriate conditions for composting process. Using nine kinetic models and nonlinear regression method, kinetic parameters were estimated and the models were analyzed with four statistical indicators. Kinetic models with four measured variables proved to be better than models with less number of measured variables. The number of measured experimental variables influences kinetics more than the number of kinetic parameters. Satisfactory fittings of proposed kinetic model to the experimental data of OM were achieved. The model is more suitable for data obtained from composting of mixtures with much higher percentage of OFMSW than percentage of poultry manure.

1. Introduction

The land scarcity problem for waste disposal in most of the urban places prompted the environmentalists searching for an appropriate processing, recycling, and disposal of municipal solid waste (MSW) as an important and integral part of a solid management system. Composting has gained an important role in municipal solid waste management. Composting is an effective and safe way for reduction of the manure's mass and volume, for destruction of pathogens and stabilization of nutrients and organic matter in it (Tiquia et al., 2000). Co-composting means composting of several types of residual matters altogether such as: olive mill wastewater with solid organic wastes (Paredes et al., 2000), rose processing waste with organic fraction of municipal solid waste (Tosun et al., 2008), poultry manure and wheat straw (Petric and Selimbašić, 2008), municipal solid wastes and sewage sludge (Fourti et al., 2010), physic nut deoiled cake with rice straw and different animal dung (Das et al., 2011), sewage sludge, barks and green waste (Watteau and Villemin, 2011).

To find out biodegradation behavior of wastes is important for an optimized design regarding composting process parameters such as processing time, size of reactor or pile area and the product quality. A high degradation rate usually indicates lower capital and operational costs for composting plants (Tosun et al., 2008). In composting, there are different process management options, but, for the majority, maximizing the decomposition rate is one of the main objectives (Baptista et al., 2010).

Kinetic model can be used as model to study composting process on an industrial scale for the optimization of the process. The degradation rate of waste can be predicted using kinetic models of the process indicators (temperature, organic matter content, moisture content, oxygen concentration, pH, C/N ratio, particle size, etc.). Kinetics of the process is used to determine waste biodegradability and generate a useful measure for the loss of organic matter during composting. It is determined by using reliable data

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