Investigation of food waste home composting process using zeolite, vermiculite, perlite and wood chips as additives

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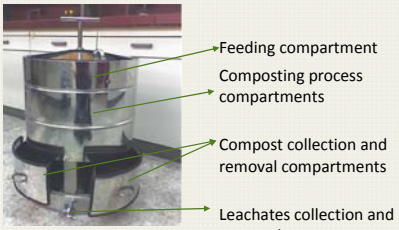
Introduction

The aerobic degradation of biowaste is considered to be one of the most widely used and tested environmentally friendly technology, which can achieve both the stabilization of the initial substrate and the production of a final product which may be further utilized as a natural fertilizer and soil improver (Barrena et al., 2014). The results of the laboratory testing of a prototype household composter in regard to its performance and the final product quality, are presented in this work. The composter operated using a mixture of bio-waste and different additives in batch conditions.

Experimental

Description of the prototype household composting reactor



Characteristics: Additives: 1) zeolite, 2) vermiculite, 3) perlite, 4) wood chips (10%w/w), time: 18 days, C/N: 30/1
Parameters examined: Temperature, moisture, conductivity, oxygen, pH, volatile solids, TOC, N-TKN, NH_4^+, NO_3^-, C/N, Na – Na_2O, K - K_2O, Ca – CaO, Mg – MgO, Phytotoxicity

Results & Discussion

1) Composting process

a) Temperature

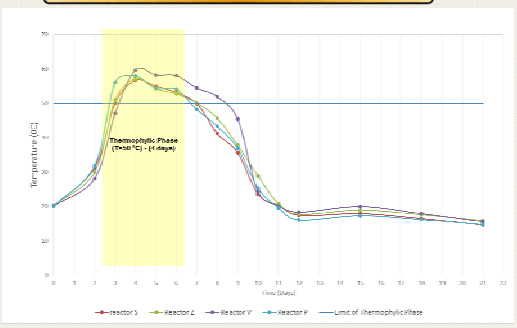
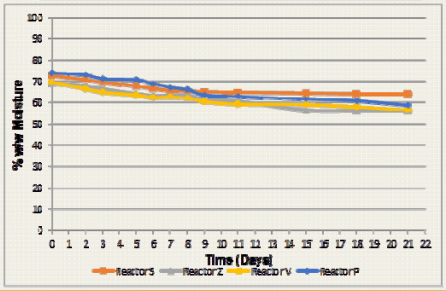


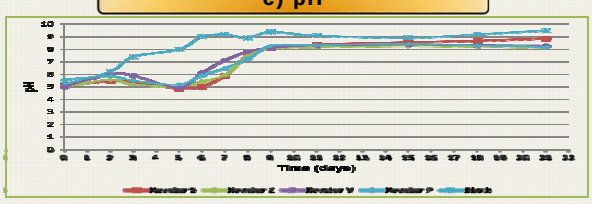
Fig. (a) depicts the temperature as a fuction of time *t* during the composting process in all the bioreactors examined. On the third day of the system's operation, a temperature rise greater than 50°C was observed in all cases. During the thermophilic phase the rate of degradation of organic matter is faster and high temperatures are observed ranging from 55 to 60°C for a total duration of 4 days (3rd-7th day)

b) Moisture



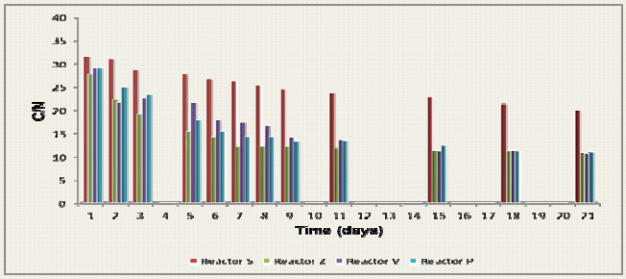
During the thermophilic phase, the moisture content is significantly reduced mainly due to the evaporation of water during the process. In the final stage of the process, it is observed that the moisture has dropped significantly in all the reactors approaching values close to 55 %w/w.

c) pH



The action of proteolytic bacteria and the subsequent ammonization part of the organic nitrogen has resulted to an increase of the pH value reaching a maximum on day 15, for the batch experiments conducted. In reactor S, at the end of the process the pH is 8.86, indicating that there was sufficient decomposition of ammonia.

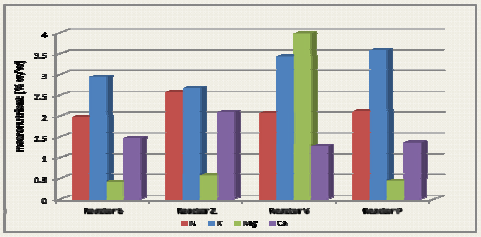
d) C/N ratio



it is observed that the reactors which had been added as additive natural mineral showed lower values C/N due to the greater decrease total organic carbon throughout the process.

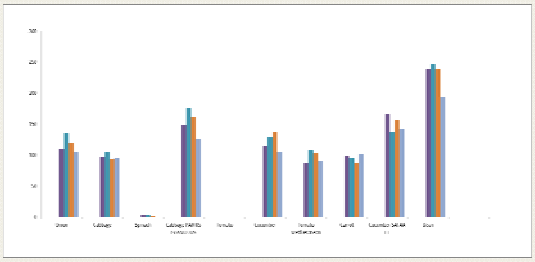
3) Characteristics of the produced compost

a) Nutrients (N, K, Mg, Ca)



The final product is nutrient in all circes due to the satisfying concentration of N, K, Mg and Ca.

b) Phytotoxicity



In fig. 3b the GI of the mature compost is recorded for all the seeds studied. The values refer to 20 and 50 days of germination period respectively.

Conclusions

1. The prototype household composting system has a good performance with respect to the composting process and the operational characteristics.
2. The composting process was successfully completed in 15 days' time for all cases while the final compost was found to have high values of GI for most of the seeds examined.
3. The presence of additives helps the composting process.
4. The addition of mineral additives such as zeolite and perlite seem to improve the physical properties of the substrate by increasing the porosity and allowing better ventilation and moistening of the substrate without taking part to the bioxidation processes. Especially for the case of zeolite, ion exchange properties and the selectivity relative to the ammonium ions contribute to reducing nitrogen losses while regulating the concentrations of ammonia and consequently the nitrate in the substrate. In addition to this, the addition of zeolite can substantially enhance the agronomic value of the produced compost while at the same time reducing the level of odor.

References

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