CO-COMPOSTING PROCESS OF SEWAGE SLUDGE AND DIFFERENT PROPORTIONS OF OFMSW

A. Delgado, J.L. García, D. Sales, R. Solera del Río
Department of Chemical Engineering, Food Technology and Environmental Technologies
Faculty of Marine Sciences and Environmental Sciences (CASEM). University of Cadiz.
Polígono Río San Pedro s/n, 11.510 Puerto Real (Cádiz). Spain. joseluis.garcia@uca.es

ABSTRACT

The evolution of the process of co-composting of sewage sludge with different proportions of organic fraction of municipal solid waste (OFMSW) by means of an open system of piling by turning has been studied. Some of the physical-chemical parameters analysed were: pH, temperature, degree of humidity, organic matter, nutrients, etc. Four composting tests have been developed (strings of triangular section) containing 16 tons of waste each one, and 10 % of pruning waste. The experimental weight relationship of OFMSW/sewage sludge was 1:0 (Pile 1); 2:1 (Pile 2); 1:2 (Pile 3) and 0:1 (Pile 4), respectively Piles were aerated by mechanical turning (windrow composting system).
Keywords: *OFMSW, sewage sludge, co-composting process.*

INTRODUCTION

The generation of urban wastes and sewage sludges has been increased in the last decades, and thus its management and correct treatment have turned to be a priority in environment politics in the European Union.

The intensive exploitation of the ground and the employment of inadequate cultivation methods and heavy machinery have led to a fall in the content of organic matter with a resulting loss of fertility. For these reasons, the search for new organic materials with low cost and constant and punctual production becomes crucial. In this sense, the municipal solid waste organic fraction (OFMSW) and the sewage sludge could constitute an important source of organic matter.

The main object of this report is to study the physicochemical evolution of the process of composting by different proportions of these wastes, obtaining an adequate agriculture product. The physical-chemical parameters analysed were: pH, temperature, degree of humidity, organic matter and nitrogen content (Costa, 1991).

MATERIALS AND METHODS

Piles were aerated by mechanical turning (windrow composting system). For assembling of piles, wastes were adequately prepared and characterized: dehydrated sewage sludge anaerobically digested and OFMSW obtained by means of a triage of voluminous, a separation of ferromagnetics and a final step with a 70 mm trommel. Previous to the mixture of residuals, the

***Table 1**. Physic-chemical compositions of raw materials.*

Raw material	pH	Moisture (%)	Organic matter (%)	NTK (%)
Sludge	8.2	81.4	50.0	4.5
OFMSW	5.8	47.4	55.6	1.5
Pruning Waste	7.4	9.8	88.0	1.5

remains of pruning were splintered, obtaining fragments between 2 and 15 cm. In Table 1, analytical details corresponding to raw materials used in the experiments are given.

The sampling was made using a drill of about 250 ml capacity, introduced manually.

RESULTS AND DISCUSSION

Evolution of temperature. - All experiments follow a common pattern containing 3 stages: starting stage (mesophilic), fermentation (thermophilic) and cooling stage (up to reaching environment temperature). In the starting stage, a sharp increase in temperature in all the experiments, reading in a few days optimal values for the aerobic fermentation of organic waste to be treated. Afterwards, temperature values were between 55 and 65ºC. Finally, a slow descent in temperature takes place (cooling stage). In the comparative analysis of results, it is easily noticed how the period of fermentation process increases as the proportion of OFMSW in the piles, these experiments reading higher temperatures (Liang, 2003).

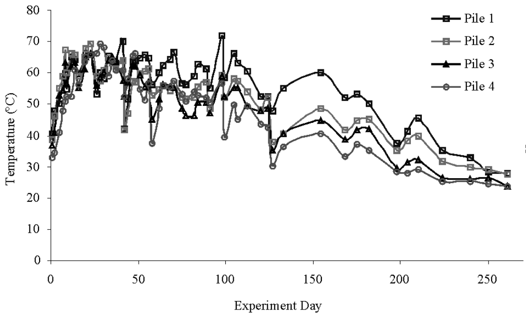

***Figure 1**. Evolution of temperature.*

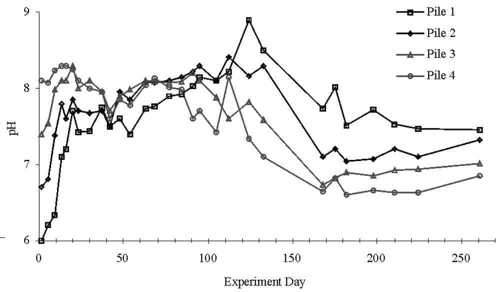

***Figure 2**. Evolution of pH.*

During the two first months of experiments a remarkable descent in the degree of moisture can be appreciated, due to climatology, the intense pace of evaporation produced by the heat generated in aerobic degradation and the turning of piles. For these reasons, piles were watering to its correction by means of watering in three times (experiment day 23, 41 and 56).

Subsequently, a lighter decrease has been observed, as consequence of a general decrease in surrounding temperature, of constant rains and a descent in the fermentation temperature. Nevertheless, moisture in pile 1 had to be corrected again on day 114 of experiment for reaching critical values (<25%) (Bari, 2001).

pH evolution.- The pH values increase in the first days of composting since little or not formation at all of organic acids. From the 4th month of experiments on a sharp decrease is produced, probably due to a lack of oxygen in the fermentation mass which makes acidogenic microorganisms and their resulting metabolites proliferate. Finally, values stay constant and close to neutrality, which characterizes mature compost.

Evolution of organic matter: The expected drop can be appreciated in the content of organic matter, due to a loss in mass as CO_2 and H_2O until it stabilized around the fourth month of experiment.

Nitrogen Total Kjeldahl.- The sludge contained piles loss nitrogen in ammoniac form during first two weeks of fermentation. This loss is consequence of following factors: high nitrogen content in sludge, daily turns, high environmental temperatures and alkaline pH.

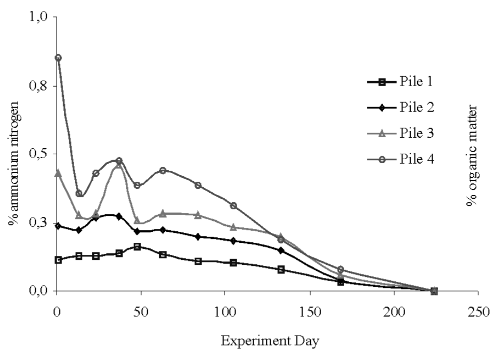

Figure 3. *Evolution of NTK.*

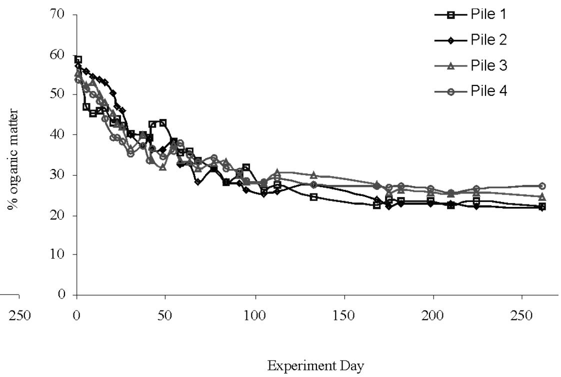

Figure 4. *Evolution of organic matter.*

Table 2. *Results of physicochemical parameters obtained during mature stage.*

Test	Organic Matter (% in weight)	NTK (% dry weight)	pH
Pile 1	21.54	1.30	7.5
Pile 2	22.12	1.40	7.2
Pile 3	26.34	1.67	7.0
Pile 4	27.48	1.76	6.8

CONCLUSIONS

The process of composting, through over turned, OFMSW, sewage sludge and its mixture in proportions 2:1 and 1:2 after more than 8 months, has provided a compost with visibly positive properties for agricultural use.

Find results obtained suggests that composting process has been performed adequately.

The addition of sewage sludge provides stabilized and innocuous compost in a shorter period of time, with a higher proportion of organic matter and nutrients besides.

Physical and Chemical parameters analysed are subject to a high degree of variability and do not take into account biological activity that takes place in the material that is being composted. Therefore, complementary methods have to be employed, especially respirometric which help determine stability and maturity in the final product.

Acknowledgements. The authors of the present project would like to express their most sincere acknowledge to the municipal company Aguas de Jerez, S.A. (AJEMSA) and SUFI, S.A. for the financing and help offered in its realisation.

REFERENCES

Bari, Q.H., Koening, A. 2001. Effect of air recirculation and reuse on composting of organic solid waste. Resour. Conserv. Recy., 33: 93-111.

Costa, F., García, C., Hernández, T., Polo, A. 1991. Residuos Orgánicos Urbanos. Manejo y Utilización. C.S.I.C. Centro de Edafología y Biología Aplicada del Segura, Murcia.

Liang, C., Das, K.C., McClendon, R.W. 2003. The influence of temperature and moisture contents regimes on the aerobic microbial activity of a biosolids composting blend. Biores. Technol., 86: 131-137.