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SCIENCE DIRECT®
Renewable Energy 31 (2006) 2017–2024
RENEWABLE ENERGY
www.elsevier.com/locate/renene

Technical Note

Anaerobic co-digestion of primary sludge and the fruit and vegetable fraction of the municipal solid wastes Conditions for mixing and evaluation of the organic loading rate

X. Gómez, M.J. Cuetos, J. Cara, A. Morán, A.I. García*

University of León, Institute of Natural Resources, Avda de Portugal no 41, León 24071, Spain

Received 7 November 2004; accepted 28 September 2005
Available online 21 November 2005

Abstract

This paper presents the results obtained for the digestion of primary sludge (PS) and co-digestion of this sludge with the fruit and vegetable fraction of municipal solid wastes (FVFMSW) under mesophilic conditions. This mixture was prepared with a PS content of 22%. The anaerobic digestion process was evaluated under static conditions and with different mixing conditions, with good results being found for the digesters with limited mixing, this representing an energy saving. The results for co-digestion of mixtures of PS + FVFMSW are better than those obtained from digestion of PS on its own. Biogas production for co-digestion is much greater thanks to the larger volatile-solid (VS) content of this feedstock. Nevertheless, biogas yield and specific gas production for the two digestion processes are similar, with values in the range 0.6–0.8 l g^{-1} VS destroyed for the first parameter and in the range 0.4–0.6 l g^{-1} VS fed for the second. The co-digestion process was also evaluated at different organic loading rates (OLR) under low mixing conditions, with stable performance being obtained even when the systems were overloaded.

Keywords: Anaerobic digestion; Mesophilic; Primary sludge; Organic fraction of municipal solid wastes (OFMSW); Mixing conditions

*Corresponding author. Tel.: +34 987 291841; fax: +34 987 291839.
E-mail address: ana.garcia@unileon.es (A.I. García).

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doi:10.1016/j.renene.2005.09.029

Nomenclature

FVFMSW	fruit and vegetable fraction of municipal solid wastes
HM	high mixing
HRT	hydraulic retention time.
LM	low mixing
OLR	organic loading rate
PS	primary sludge
SGP	specific gas production
SC	static conditions
TS	total solids
VS	volatile solids

1. Introduction

Wastewater treatment plants (WWTPs) in most of the developing countries have only primary sedimentation treatments, while in developed countries many plants are applying strategies to reduce the amount of waste activated sludge. The amount of sludge generated is dependent on the size of the WWTP and the treatment option used. Previous to any land disposal, the sludge must be stabilized. Land application of biosolids is the choice which is most compatible with sustainable development principles, as long as the limitations set by local regulations are complied with, in order to avoid any harm to soils.

Municipal solid wastes (MSW) are another type of residue that is affronting more restrictive legislation with respect to landfill disposal of the biodegradable fraction. Treatment of this organic fraction is currently carried out through aerobic composting or anaerobic digestion. These technologies can maximize recycling and recovery of waste components [1]. Due to the CO_2 emissions associated with the aerobic treatments and the restrictions that will probably apply to these emissions in the near future, anaerobic digestion will become the treatment alternative that is most in line with sustainable development. However; one of the problems most frequently found during biological processing of the organic fraction of MSW is the high C:N ratio of these residues. To circumvent this problem, several authors have proposed co-digestion of the organic fraction of MSW, either with sewage sludge from WWTPs or residues from livestock farms [2–4]. The benefits of co-digestion include: dilution of potential toxic compounds, improved balance of nutrients, synergistic effects of microorganisms, increased load of biodegradable organic matter and better biogas yield [5].

Co-digestion is of considerable technical interest, since it allows the use of existing installations and greatly increases biogas production and the energy produced in co-generation units. An additional advantage of the process is the obtaining of a valuable sludge which can eventually be used as a soil amendant after minor treatments [6,7].

The purpose of this research was to compare digestion of primary sludge (PS) as against co-digestion of this waste together with the fruit and vegetable fraction of municipal solid wastes (FVFMSW), evaluating production of gas, the influence of mixing conditions and performance of the system under different organic loading rates.