



Destabilization of an anaerobic reactor by wash-out episode: Effect on the biomethanization performance

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H I G H L I G H T S

- The effects of a transient wash-out episode on biomethanization performance were investigated.
- The acetate-utilizing methanogenic *archaea* are washed-out at 10-day SRT.
- An important accumulation of acetic acid is observed at 10-day SRT.
- The methane production drops near to zero at 10-day SRT.
- The biomethanization performance is restored when 15-day SRT is imposed.

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In anaerobic processes, the volatile fatty acid profile (VFA) is closely related with the methanogenic activity and, hence, the knowledge of the relationship between these two parameters (VFA evolution and methane production) is fundamental to characterize the behavior of anaerobic reactors for treatment of organic wastes.

In this study, a destabilization episode in a 5-l continuously stirred tank reactor (CSTR) at laboratory scale was induced to evaluate the influence of a wash-out episode in the biomethanization performance/efficiency (at thermophilic-dry conditions) of the organic fraction of municipal solid waste coming from a full-scale mechanical biological treatment (MBT) plant.

To do this, from a stable reactor operating at 15-day solids retention time (SRT), the organic loading rate was increased in two stages: firstly from 2.93 gVS/L_R day^{−1} (15-day SRT) to 3.66 gVS/L_R day^{−1} (12-day SRT) during 36 days and secondly from 3.66 gVS/L_R day^{−1} to 4.39 gVS/L_R day^{−1} (10-day SRT) along 30 days.

The results indicate that acetate-utilizing methanogenic *archaea* are practically washed-out during the destabilization episode at 10-day SRT. Thus, the VFA and methane profiles indicate that this group is the first population of microorganisms unbalanced on the system, since the methane production drops rapidly near to zero and an important accumulation of VFA (acetic acid mainly), from 314 mg/l to 552 mg/l (increment of 75.8%), was observed.

Finally, after the destabilization episode at 10-day SRT and in order to estimate the capacity of the system to recover the biomethanization performance, the SRT was increased from 10 to 15 days and then it was gradually decreased in two stages again: first from 15 to 13 days and finally from 13 to 12 days (initial value of SRT tested in this study). The results have shown that when the same SRT (12 days) is imposed to the reactor twice and a destabilization episode by wash-out occurs between these periods, it is not possible a full recovery of the biomethanization performance.

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1. Introduction

The anaerobic digestion (AD) has been commonly employed as a suitable strategy for managing organic wastes such as the organic

fraction of municipal solid wastes (OFMSWs) [1]. This process presents many advantages as low net power consumption and biogas generation mainly with high content in methane and/or hydrogen. With regard to the latter aspect, the AD may be optimized to generate biogas rich in methane by biomethanation process or hydrogen through *Dark Fermentation* (acidogenic fermentation). It is very important to highlight that nowadays the hydrogen is considered a promising energetic vector of the future and in this case both gases

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