Evaluation of process performance, energy consumption and microbiota characterization in a ceramic membrane bioreactor for ex-situ biomethanation of H_2 and CO_2

Natalia Alfaro, María Fdz-Polanco, Fernando Fdz-Polanco, Israel Díaz

PII: S0960-8524(18)30284-0
DOI: https://doi.org/10.1016/j.biortech.2018.02.087
Reference: BITE 19597

To appear in: *Bioresource Technology*

Received Date: 28 December 2017
Revised Date: 16 February 2018
Accepted Date: 17 February 2018

Please cite this article as: Alfaro, N., Fdz-Polanco, M., Fdz-Polanco, F., Díaz, I., Evaluation of process performance, energy consumption and microbiota characterization in a ceramic membrane bioreactor for ex-situ biomethanation of H_2 and CO_2, *Bioresource Technology* (2018), doi: https://doi.org/10.1016/j.biortech.2018.02.087

Evaluation of process performance, energy consumption and microbiota characterization in a ceramic membrane bioreactor for ex-situ biomethanation of H_2 and CO_2

Natalia Alfaro[1], María Fdz-Polanco[1], Fernando Fdz-Polanco[1], Israel Díaz*[1]

[1] Department of Chemical Engineering and Environmental Technology, Escuela de Ingenierías Industriales, Sede Dr. Mergelina, University of Valladolid, Dr. Mergelina s/n, 47011 Valladolid, Spain.

* Corresponding author: israel.diaz@iq.uva.es, Phone: +34983184598.

E-mail addresses: nataliaalfaro@iq.uva.es, maria@iq.uva.es, ffp@iq.uva.es

Abstract

The performance of a pilot ceramic membrane bioreactor for the bioconversion of H_2 and CO_2 to bioCH_4 was evaluated in thermophilic conditions. The loading rate was between 10 and 30 $m^3H_2/m^3_{reactor}$ d and the system transformed 95% of H_2 fed. The highest methane yield found was 0.22 m^3CH_4/m^3H_2, close to the maximum stoichiometric value (0.25 m^3CH_4/m^3H_2) thus indicating that *archaeas* employed almost all H_2 transferred to produce CH_4. k_La value of 268 h^{-1} was reached at 30 $m^3H_2/m^3_{reactor}$ d. DGGE and FISH revealed a remarkable *archaeas* increase related to the selection-effect of H_2 on community composition over time. *Methanothermobacter thermautotrophicus* was the *archaea* found with high level of similarity. This study verified the successful application of membrane technology to efficiently transfer H_2 from gas to the liquid phase, the development of a hydrogenotrophic community from a conventional thermophilic sludge and the technical feasibility of the bioconversion.