

Accepted Manuscript

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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 H₂ and CO₂, *Bioresource Technology* (2018), doi: <https://doi.org/10.1016/j.biortech.2018.02.087>

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Evaluation of process performance, energy consumption and microbiota characterization in a ceramic membrane bioreactor for ex-situ biomethanation of H₂ and CO₂

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Abstract

The performance of a pilot ceramic membrane bioreactor for the bioconversion of H₂ and CO₂ to bioCH₄ was evaluated in thermophilic conditions. The loading rate was between 10 and 30 m³H₂/m³_{reactor} d and the system transformed 95% of H₂ fed. The highest methane yield found was 0.22 m³CH₄/m³H₂, close to the maximum stoichiometric value (0.25 m³CH₄/m³H₂) thus indicating that *archaeas* employed almost all H₂ transferred to produce CH₄. k_La value of 268 h⁻¹ was reached at 30 m³H₂/m³_{reactor} d. DGGE and FISH revealed a remarkable *archaeas* increase related to the selection-effect of H₂ 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 H₂ from gas to the liquid phase, the development of a hydrogenotrophic community from a conventional thermophilic sludge and the technical feasibility of the bioconversion.

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