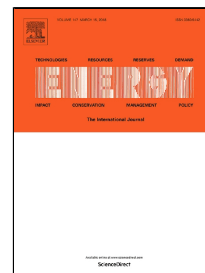


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Assessment of continuous fermentative hydrogen and methane co-production using macro- and micro-algae with increasing organic loading rate

Lingkan Ding, Enrique Chan Gutierrez, Jun Cheng, Ao Xia, Richard O'Shea, Amita Jacob Guneratnam, Jerry D. Murphy



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4 Lingkan Ding ^{a,b,1}, Enrique Chan Gutierrez ^{b,1}, Jun Cheng ^{a,*}, Ao Xia ^c, Richard

5 O'Shea ^b, Amita Jacob Guneratnam ^b, Jerry D. Murphy ^{b,d}

6 ^a State Key Laboratory of Clean Energy Utilization, Zhejiang University, Hangzhou 310027, China

7 ^b MaREI Centre, Environmental Research Institute, University College Cork, Cork, Ireland

8 ^c Key Laboratory of Low-grade Energy Utilization Technologies and Systems, Chongqing University,

9 Chongqing 400044, China

10 ^d School of Engineering, University College Cork, Cork, Ireland

11 ¹ Equal contributors

12

13 **Abstract**

14 A two-stage continuous fermentative hydrogen and methane co-production using
15 macro-algae (*Laminaria digitata*) and micro-algae (*Arthrospira platensis*) at a C/N
16 ratio of 20 was established. The hydraulic retention time (HRT) of first-stage H₂
17 reactor was 4 days. The highest specific hydrogen yield of 55.3 mL/g volatile solids
18 (VS) was obtained at an organic loading rate (OLR) of 6.0 gVS/L/d. In the second-
19 stage CH₄ reactor at a short HRT of 12 days, a specific methane yield of 245.0
20 mL/gVS was achieved at a corresponding OLR of 2.0 gVS/L/d. At these loading rates,
21 the two-stage continuous system offered process stability and effected an energy yield
22 of 9.4 kJ/gVS, equivalent to 77.7% of that in an idealised batch system. However,
23 further increases in OLR led to reduced hydrogen and methane yields in both reactors.
24 The process was compared to a one-stage anaerobic co-digestion of algal mixtures at
25 an HRT of 16 days. A remarkably high saline level of 13.3 g/L was recorded and
26 volatile fatty acid accumulation were encountered in the one-stage CH₄ reactor. The
27 two-stage system offered better performances in both energy return and process
28 stability. The gross energy potential of the advanced gaseous biofuels from this algal
29 mixture may reach 213 GJ/ha/yr.

* Corresponding author: Prof. Dr. Jun Cheng, State Key Laboratory of Clean Energy Utilization, Zhejiang University, Hangzhou 310027, China. Tel.: +86 571 87952889; fax: +86 571 87951616. E-mail: juncheng@zju.edu.cn

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