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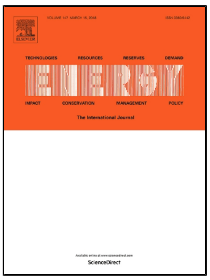

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Assessment of continuous fermentative hydrogen and methane co-production using macro- and micro-algae with increasing organic loading rate

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Abstract

A two-stage continuous fermentative hydrogen and methane co-production using macro-algae (*Laminaria digitata*) and micro-algae (*Arthrospira platensis*) at a C/N ratio of 20 was established. The hydraulic retention time (HRT) of first-stage H_2 reactor was 4 days. The highest specific hydrogen yield of 55.3 mL/g volatile solids (VS) was obtained at an organic loading rate (OLR) of 6.0 gVS/L/d. In the second-stage CH_4 reactor at a short HRT of 12 days, a specific methane yield of 245.0 mL/gVS was achieved at a corresponding OLR of 2.0 gVS/L/d. At these loading rates, the two-stage continuous system offered process stability and effected an energy yield of 9.4 kJ/gVS, equivalent to 77.7% of that in an idealised batch system. However, further increases in OLR led to reduced hydrogen and methane yields in both reactors. The process was compared to a one-stage anaerobic co-digestion of algal mixtures at an HRT of 16 days. A remarkably high saline level of 13.3 g/L was recorded and volatile fatty acid accumulation were encountered in the one-stage CH_4 reactor. The two-stage system offered better performances in both energy return and process stability. The gross energy potential of the advanced gaseous biofuels from this algal mixture may reach 213 GJ/ha/yr.

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