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Optimization of biohydrogen and methane recovery within a cassava ethanol wastewater/waste integrated management system

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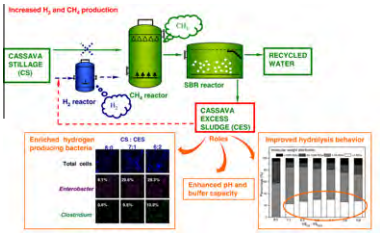
HIGHLIGHTS

- Co-digestion of CS with CES could stimulate the hydrogen and methane production.
- CS could co-digest with CES without any pretreatment or extra addition.
- Hydrogen producing and consumption bacteria were increased after CES recycled.
- The hydrolysis behavior was improved by co-digestion through GFC analysis.
- The biogas production was combined with the wastewater/waste integrated management.

GRAPHICAL ABSTRACT



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ABSTRACT

Thermophilic co-fermentation of cassava stillage (CS) and cassava excess sludge (CES) were investigated for hydrogen and methane production. The highest hydrogen yield (37.1 ml/g-total-VS added) was obtained at VS_{CS}/VS_{CES} of 7:1, 17% higher than that with CS digestion alone. The CES recycle enhanced the substrate utilization and improved the buffer capacity. Further increase the CES fraction led to changed VFA distribution and more hydrogen consumption. FISH analysis revealed that both hydrogen producing bacteria and hydrogen consuming bacteria were enriched after CES recycled, and the acetobacteria percentage increased to 12.4% at VS_{CS}/VS_{CES} of 6:2. Relatively high efficient and stable hydrogen production was observed at VS_{CS}/VS_{CES} of 5:3 without pH adjusted and any pretreatment. The highest total energy yield, the highest COD and VS degradation were obtained at VS_{CS}/VS_{CES} of 7:1. GFC analysis indicated that the hydrolysis behavior was significantly improved by CES recycle at both hydrogen and methane production phase.

1. Introduction

According to the "Statistical Communiqué of the People's Republic of China on the 2011 National Economic and Social Development", the total energy consumption in 2011 was estimated to amount to 3.48 billion tons of standard coal equivalent, above 7% over 2010 (National Bureau of Statistics of China, 2011). However, the environmental and economical problems associated with the burning of fossil fuels have drawn researchers' attention to more sustainable and non-polluting energy sources, and the government has planned to increase the proportion of non-fossil fuels in primary energy consumption in the coming 12th Five-Year Plan.

Bioethanol is a form of renewable fuel which is widely used all over the world, and cassava-based bioethanol is widely produced in China due to its economic advantages (Jansson et al., 2009;

Abbreviations: CS, cassava stillage; CES, cassava excess sludge; HY, hydrogen yield; MY, methane yield.

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