Hydrogen and methane production from waste activated sludge and food waste by two-stage fermentation process

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Abstracts: This study focused on the characteristics on hydrogen and methane production from co-digestion of waste activated sludge and food waste in a two-stage anaerobic fermentation process. The fermentation system consisted of a thermophilic (55℃) hydrogen production reactor and a mesophilic (37℃) methane production reactor with the digested sludge recirculation rate of 1:1. Hydraulic retention time (HRT) and organic loading rate (OLR) were investigated to obtain the optimal condition for highest energy yield. The hydrogen yield was increased when the HRT was gradually reduced from 3.25 d to 0.8 d, and the highest hydrogen yield was 207.5 ml/g-$VS_{removed}$ at the HRT of 0.8 d. However, the methane yield was firstly decreased and then increased with the HRT, and the highest methane yield was 554.3 ml/g-$VS_{removed}$ at the HRT of 6 d. The highest energy yield of 6.2 kJ/g-VS based on the combustion heat of the produced biogas was obtained at HRT of 1.1 d for hydrogen production and 6 d for methane production, and the corresponding volatile solid (VS) removal efficiency was 54.2%. The hydrogen and methane content in each reactor were as high as 54.3-60.9% and 71.5-81.3% during the two-stage fermentation experiment. The dominant volatile fatty acids were acetate and butyrate in the thermophilic biohydrogen process. As a conclusions, the two-stage co-digestion system treating food waste and waste activated sludge for hydrogen and methane production could be operated in high solid conditions and maintained stable.

Keywords: Two-stage fermentation, Hydrogen production, Methane production, waste activated sludge, food waste