Separate production of H_2 and CH_4 from ethanol wastewater using two-stage UASB: Micronutrient transformation

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Abstract

In the present, the major energy source used around the world is fossil fuels which their quantities are limiting and depleting. Meanwhile, the global energy demand is increased contribute to an increase in the price of fuels. Interestingly, hydrogen and methane are an interesting alternative energy source with several applications to replace partially the consumption of fossil fuels and solving the global warming problem. The objective of this study is to determine an optimum COD loading rate for both maximum production of hydrogen and methane from ethanol wastewater using a two-stage upflow anaerobic sludge blanket (UASB) system under mesophilic temperature (37°C) with a constant recycle ratio of 1:1 (final effluent flow rate : feed flow rate). The first (hydrogen) UASB unit having 4 L liquid holding volume was controlled at pH 5.5 but the second (methane) UASB unit having 24 L liquid holding volume has no pH control. The two-stage UASB system operated at different COD loading rates in order to determine an optimum COD loading rate for both maximum production rates and yield of hydrogen and methane. In addition, the transformation of micronutrients will be also investigated. The result showed that at the maximum COD loading rate of 20 kg/m^3 d based on total UASB working volume, the produced gas from the hydrogen UASB unit can get the maximum hydrogen yield of 1.79 mL/g COD removed and the specific hydrogen production rate of 7.54 ml H_2/L_R d. The produced gas from the methane UASB unit can get the maximum methane yield of 467.90 mL/g COD removed and the specific methane production rate of 2950.41 ml CH_4/L_R d. In addition, the microorganisms which producing both of hydrogen and methane production need micronutrients to improve its activity. The investigating of micronutrients in feed ethanol wastewater showed tended to lack of some micronutrients. Therefore, the supplementation of the micronutrients was required for the raw wastewater before feeding into the system.