Biohydrogen Production from Cane Molasses by Mutated Enterobacter aerogenes ADH43 in Continuous Stirred Tank Reactor System with Varying Dilution Rate and its Application into Fuel Cell for Generating Electricity

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Abstract

Hydrogen gas (H₂) produced by microorganism (biohydrogen) is acknowledged to be a clean and renewable energy resource for the future because its production does not require a large amount of energy and no COx, NOx, and SOx emission is produced. Besides, the oxidation process of biohydrogen produces water and high energy (122 kJ/g) without waste products, unlike fossil fuel. The aim of this research is to investigate the effect of dilution rate to biohydrogen production in continuous stirred tank reactor (CSTR) system. The biohydrogen that was produced was directly inserted into a fuel cell to generate electricity. The substrate used in this research was cane molasses. The mutated bacteria used was Enterobacter aerogenes ADH43 that was a mutant bacteria having a inhibited metabolic pathway for acid production. Faculative anaerobe fermentation was conducted into stirred tank reactor using continuous system at 37 °C of temperature and 40 rpm of agitation speed, dilution rate of (D) 0.15 ;0.3; 0.45; 0.60 (h⁻¹). Biohydrogen produced was assessed after inserting it into a fuel cell to generate electricity and measuring voltages produced. The result showed that the highest H₂ production was achieved at continuous system resulted in 0.30 h⁻¹ of optimum dilution rate. The maximum H₂ volume of 9.76 l H₂/l sugar, the yield of 1.84 mol H₂/mol sugar, and the flow rate of 114.66 ml H₂/minute were obtained. Furthermore, colony count of 9.81 log cfu/ml, pH of 5.73, maximum electrical current of 0.38 A, electrical power of 2.20 Watt, and electrical voltage of 5.75 volt after given resistance using LED of 25 ohm were also reached.

Keywords: H₂ production, Enterobacter aerogenes, molasses, CSTR and Fuel Cell
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