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Usage of Crude Glycerol for Biological Hydrogen Production, Experiments and Analysis

Authors : Ilze Dimanta, Zane Rutkovska, Vizma Nikolajeva, Janis Kleperis, Indrikis Muiznieks

Abstract : Majority of word's steadily increasing energy consumption is provided by non-renewable fossil resources. Need to find an alternative energy resource is essential for further socio-economic development. Hydrogen is renewable, clean energy carrier with high energy density (142 MJ/kg, accordingly – oil has 42 MJ/kg). Biological hydrogen production is an alternative way to produce hydrogen from renewable resources, e.g. using organic waste material resource fermentation that facilitate recycling of sewage and are environmentally benign. Hydrogen gas is produced during the fermentation process of bacteria in anaerobic conditions. Bacteria are producing hydrogen in the liquid phase and when thermodynamic equilibrium is reached, hydrogen is diffusing from liquid to gaseous phase. Because of large quantities of available crude glycerol and the highly reduced nature of carbon in glycerol per se, microbial conversion of it seems to be economically and environmentally viable possibility. Such industrial organic waste product as crude glycerol is perspective for usage in feedstock for hydrogen producing bacteria. The process of biodiesel production results in 41% (w/w) of crude glycerol. The developed lab-scale test system (experimental bioreactor) with hydrogen micro-electrode (Unisense, Denmark) was used to determine hydrogen production yield and rate in the liquid phase. For hydrogen analysis in the gas phase the RGAPro-100 mass-spectrometer connected to the experimental test-system was used. Fermentative bacteria strains were tested for hydrogen gas production rates. The presence of hydrogen in gaseous phase was measured using mass spectrometer but registered concentrations were comparatively small. To decrease the hydrogen partial pressure in liquid phase reactor with a system for continuous bubbling with inert gas was developed. H2 production rate for the best producer in liquid phase reached 0,40 mmol H2/l, in gaseous phase - 1,32 mmol H2/l. Hydrogen production rate is time dependent – higher rate of hydrogen production is at the fermentation process beginning when concentration increases, but after three hours of fermentation, it decreases.

Keywords : bio-hydrogen, fermentation, experimental bioreactor, crude glycerol
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