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Biological hydrogen production from environmental sample in tropical countries

MAINTINGUER, S.I[1]., LAZARO, C.Z[1]., SAKAMOTO, I.K[1]., VARESCHE. M.B.A.[1]
[1]USP- Universidade de São Paulo-Escola de Engenharia de São Carlos - Departamento de Hidráulica e Saneamento – Laboratório de Processos Biológicos - São Carlos-– São Paulo, Brazil
mainting2008@gmail.com

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The hydrogen gas is regarded as clean and renewable energy source, since it generates only water during combustion when used as fuel. It shows 2.75 times more energy content than any hydrocarbon and it can be converted into electrical, mechanical energy or heat. Inoculum sources have been successfully tested for hydrogen biological production in temperate climate countries as sludge treatment plants sewage, sludge treatment plant wastewater, landfill sample, among others. However, hydrogen biologic production with inoculum from environmental samples such as sediment reservoirs, especially in tropical countries like Brazil, is rarely investigated. Reservoirs and fresh water lake sediment may contain conditions for the survival of a wide variety of microorganisms which use different carbon sources mainly glucose and xylose, in the fermentation. Glucose is an easily biodegradable, present in most of the industrial effluents and can be obtained abundantly from agricultural wastes. A wide variety of wastewater resulting from agriculture, industry and pulp and paper processed from wood may contain xylose in its constitution. Such effluent contains glucose and xylose concentrations of about 2 g/L.
In this sense, this work verified hydrogen biological production in anaerobic batch reactor (1L), at 37 ° C, initial pH 5.5, headspace with N_2 (100%), Del Nery medium, vitamins and peptone (1 g/L), fed separately with glucose (2g/L) and xylose (2 g/L). The inoculum was taken from environmental sample (sediment reservoir Itupararanga - Ibiúna - SP-Brazil). It was previously purified in serial dilutions at H_2 generation (10^{-5}, 10^{-7}, 10^{-10}), and heat treated (90º C - 10 min) later to inhibited the H_2 consumers. The maximum H_2 generations obtained in both tests were observed at 552 h, as described below. At the reactors fed with glucose and xylose were observed, respectively, 9.1 and 8.6 mmol H_2/L, biomass growth (0.2 and 0.2 nm); consumption of sugar concentrations 53.6% (1.1 glucose g/L) and 90.5% (1.8 xylose g/L); acetic acid generation (124.7 mg/L and 82.7 mg/L), butyric acid (134.0 mg/L and 230.4 mg/L) and there wasn't methane generation in the reactors. Microscopic analysis of biomass in anaerobic reactors showed the predominance of Gram positive rods and rods with endospores, whose morphology is characteristic of H_2-generating bacteria, in both tests. These species were selected from the natural environment. In DGGE analysis performed difference were observed between populations from inoculum and in tests. This analysis confirmed that some species of bacteria were selected which remained under the conditions imposed on the experiment. The efficiency of the pre-treatment of inoculum and the imposition of pH 5.5 inhibited methane-producing microorganisms and the consumers of H_2. Therefore, the experimental conditions imposed allowed the attainment of bacterial consortium of producer H_2 taken from an environmental sample with concentration of xylose and glucose similar to the ones of the industrial effluents.

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