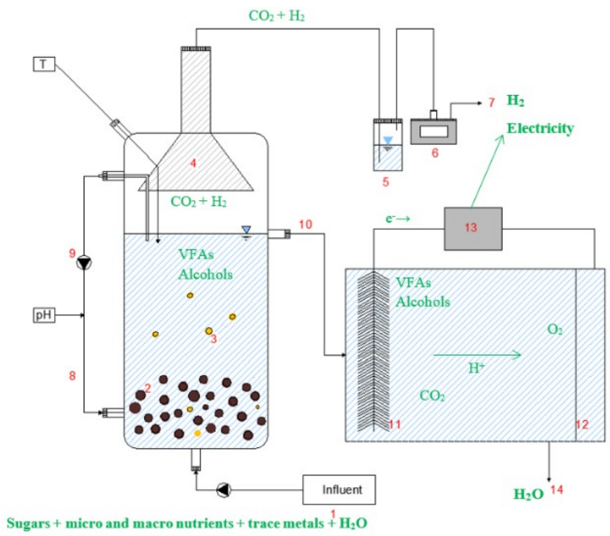
Comparative and sequential biohydrogen and bioelectricity production from industrial wastewaters

PhD research June 2015 - May 2018

Social Impact

The intensive use of fossil fuels for energy production is leading to a rapid depletion of the global energy reserves and to the emission of greenhouse gases. For this reason, energy production from renewable sources is supposed to sharply increase in the next years. Many industries, such as food industries and pulp and paper industries, produce high strength organic wastewaters that need to be treated before discharging. Traditional aerobic treatment is not a sustainable alternative for high organic concentration wastewaters as a huge quantity of oxygen is required for the complete oxidation of the substrate. The stringent discharge limits and the need for renewable energy are causing the production of energy from wastewaters to play a key role in the near future. Unless methane production is a well developed technology, hydrogen gas is a promising alternative, as its heating values are the highest between fuels. Furthermore, hydrogen is a clean fuel, producing only water upon combustion. Dark fermentation side products, mainly alcohols and volatile fatty acids, are desirable substrates for electricity production by using microbial fuel cells (MFCs).

Technological Challenges



Although some industrial processes involving organic compounds, such as chemithermomechanical pulping (CTMP), produce wastewater at high temperature, continuous biological hydrogen production under hyperthermophilic (>60 °C) conditions has not been widely studied. High temperature can be advantageous for hydrogen production, because it can enhance hydrogen yields and reduce the contamination by pathogens and hydrogen consuming bacteria. Attached biomass systems, such as fluidized bed reactors (FBR) are characterized by the adhesion of microbial biofilms on inert surfaces, retaining high active biomass content and enabling high organic loading and conversion rates in the reactors.
In the same way of biohydrogen reactor, thermophilic MFCs, marginally studied, may be the key to improve electricity generation.

The main objective of this study is the implementation of a two-steps system (FBR+MFC) for the sequential production of biohydrogen and bioelectricity from sugar containing wastewaters under hyperthermophilic (70 °C) conditions.

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