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COMPARISON OF BIOHYDROGEN PRODUCTION IN FLUIDIZED BED BIOREACTOR AT ROOM TEMPERATURE AND 35°C

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Abstract

In the last 10 years, interest on biohydrogen has increased exponentially. Recent studies have found that favorable immobilized-cell anaerobic hydrogen production systems include anaerobic fluidized bed reactors. Even though AFBR exhibits positive features for the production of biogases such as H_2 it has been used primarily for the treatment of wastewater. To our knowledge, there are no studies for H_2 production by AFBR at low temperatures. Therefore, this work was aimed to evaluate the H_2 production in an anaerobic fluidized bed reactor using two incubation temperatures: room temperature and 35 °C.

The laboratory-scale AFBRs consisted of glass columns loaded with 1 L of granular activated carbon (1-2 mm diameter) colonized by an anaerobic consortium (with heat-shock pretreatment, 90ºC) . Sucrose (8 g/L) was used as substrate without addition of buffer solution. The hydraulic residence time was 1 day; the incubation temperature was 35ºC (AFBR-M) and room temperature (AFBR-R).

The average H_2 concentration in the biogas in AFBR-R was 1.8 times superior than AFBR-M (54% and 31% respectively. pH ranged from 4.85 to 4.0 despite no buffer solution was added. It was observed CH_4 in the biogas of AFBR-R until the pH dropped down to 4.5. The H_2 productivity in AFBR-R was 2.3 times superior that in AFBR-M (1332.9 and 577.2 mLH_2/L_{bed} day, respectively. Acetic acid (HAc), Butyric acid (HBu), Propionic acid (HPr), Ethanol (EtOH) and Butanol were the soluble microbial products (SMP) detected in this fermentation. The volatile fatty acid (VFA) contributed to most of the SMP at both temperatures with ratios VFA/SP_{AFBR-A} of 26.3 and VFA/SP_{AFBR-M} 4.2 (VFA/SP: volatile fatty acid/solvents products).

Our results agree with those found by Gadhamshetty et al. (2009) in batch reactors operated at 22°C and 37°C in a CSTR reactor, they observed that the H_2 production was 1.3 times superior in a reactor operated at lower temperatures (22ºC). This result could be attributed to the gradual changes in pH induced by slower kinetics at lower temperature. In conclusion the H_2 production in an AFBR at room temperature showed encouraging results for H_2 production in submerged fermentation of soluble substrates.