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EFFECT OF TOTAL SOLIDS CONTENT OF THE FEEDSTOCK, TEMPERATURE AND MASS RETENTION TIME ON THE PERFORMANCE OF BIOHYDROGENIC SOLID SUBSTRATE FERMENTATION OF ORGANIC WASTE

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Abstract

On the edge of oil age decline, hydrogen is regarded as an alternative to fossil fuels. An interesting technology for biohydrogen production is dark fermentation in terms of its productivities and relative ease of the process. Research performed in this field is mostly done at low solids (<10 %TS) fermentation. Although less studied, solid substrate fermentation presents advantages such as reactor volume reduction, no water addition, no leachate generation and high H_2 productivities. Therefore our purpose was to evaluate the effect of the total solids content, temperature and mass retention time on semi-continuous hydrogen fermentation at high solids contents of the organic fraction of municipal solid waste.

The set-up and operation of bioreactors were performed as reported elsewhere. The organic fraction of municipal solid waste consisted of dried food wastes from cafeteria (60% w/w) and waste office paper (40% w/w). We followed a 2^3 experimental design for evaluating the effect of the total solids content (TS, 21 or 35 %), temperature (35 or 55 ºC) and mass retention time (MRT, 21 and 14 d) on semi-continuous hydrogen production.

It was observed that hydrogen productivities (I_{H2}) were positively influenced by 21 %TS, 21 d MRT and thermophilic regime. Indeed, I_{H2} averaged up to 123 NmL $H_2/(kg_{wmr}$ d) with factor 21 %TS.

The highest I_{H2} was related to the higher organic acids to solvents ratio (ρ) and the lowest production of lactic acid.

Moreover, the factors were significant in the order TS > temperature > MRT. Significant interactions amidst factors only occurred between TS and temperature or MRT.

High total solids content affected negatively the hydrogen productivity. Variations and inhibition of hydrogen production were related to low pH and high lactic acid and solvents production. This was in agreement with reports of a strong correlation between high lactic acid concentrations and inhibition of hydrogenesis.

Key words: biohydrogen, high total solids, municipal organic solid wastes