USE OF ORGANIC FRACTION OF SOLID WASTE FOR HYDROGEN PRODUCTION IN A SEQUENCING BATCH REACTOR

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Introduction. The importance to produce hydrogen (H_2) has increased due to its benefits compared with other fuels, it combustion generates only water as sub-product and has a high specific energy compared to other fuels (1). The organic fraction of urban solid waste (OFSW) represents more than 60% of total urban waste and includes 75% of easy to degrade matter (2). Using a fermentative process, the organic matter is transformed into H_2, CO_2 and organic acids and alcohols, this make feasible the biological production of H_2 (3). For this reason the objective was to evaluate the H_2 production form OFSW in a Sequencing Batch Reactor (SBR).
The objective of this study is to determine the optimal HRT for biological hydrogen production.

Methods. An SBR of 1L (exchange volume of 50%) was used to produce H_2 from the fermentation of OFSW using four different hydraulic retention times, HRT (72, 24, 12 and 6 h). An automatic temperature and mixing controller were used to maintain constant conditions (35±1ºC and 80 rpm). The OFSW was collected in a cafeteria (avoiding inert material as plastic, PET or glass). The waste was homogenized by a blender to obtain particle sizes < 0.5 mm. 5 g of VS of OFSW was added as a substrate in each degradation cycle. The pH for all the experiments was adjusted to 7.0 and a citrate buffer 1M was used in order to maintain pH around 5.5 at the end of the reaction phase (3). The reactor was inoculated with hydrogen producers microorganisms selected by a thermal shock pre-treatment (103 – 105 °C during 1 h in an oven). H_2, CO_2, methane and volatile fatty acids (VFA) were determined by gas chromatography (SRI 8610 C and VARIAN 330 C).

Results. The OFSW used in this study showed the next characteristics: Moisture 74±2%, TS 239±19g/L, VS 212±22g/L, density 1115±26g/L, NH_3-N 387±62mg/L, COD_{total} 162±26g/L, pH of 5.2±0.4 and Alkalinity 25 mg $CaCO_3$/L. Figure 1 shows the kinetics of H_2 production adjusted to the Gompertz model for the different HRT. The biogas in all the cases was composed of only H_2 and CO_2, with no methane detected for any case. It was observed that for all the cases, more than the 80% of the volumetric quantity of H_2 was produced during the first 8 hours of reaction.

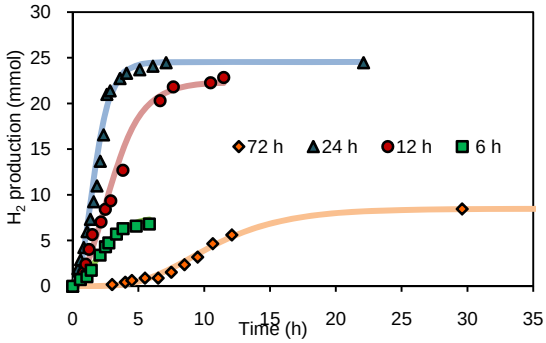

Fig.1. Biohydrogen production during the SBR operation at different HRT (72, 24, 12 and 6 h)

Table 1 showed the values resulted in each HRT. The maximum H_2 percentage in gas, maximum volumetric H_2 production (H_{max}) and the maximum H_2 production rate (R_{max}) were obtained at HRT of 24 h. The values for H_2 in biogas varied from 22 to 48%. Acetic acid was the main VFA obtained. Higher propionic acid production was observed in HRT of 6 h.

Table 1. Experimental results for hydrogen productivity during four different reaction times.

TRH (h)	R_{max} (mL H_2 / h)	H_{max} (mL H_2)	mmolH_2	% H_2
72	78.1±56.8	369.7±270	16.5±12	23.6±11
24	328.7±144	757.8±391	33.8±17	48±6
12	186.4±150	460±253	20.5±11	28.1±13
6	242.5±311	282.5±246	12.6±11	22.3±14

Conclusions. The highest H_2 production was obtained applying an HRT of 24 with 328.7 mL H_2/h, followed by the HRT of 12 h.

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