PRODUCTION OF HYDROGEN BY DARK FERMENTATION: EVALUATION OF THE BIOMASS ACTIVITY

M. P. Díez, E. Barahona, M.A. de la Rubia, A.F. Mohedano, J.J. Rodríguez, E. Diaz.

Department of Chemical Engineering, Faculty of Sciences, Universidad Autonoma de Madrid, Campus de Cantoblanco, 28049, Madrid (Spain)

e-mail: mario.perez@uam.es

INTRODUCTION

Biohydrogen is a promising energy fuel since it is clean, renewable and presents a high-energy value (142 kJ/g), while no contribute to greenhouse effects [1]. Its production from biological routes, such as dark fermentation, is emerging as an upcoming process based on the conversion of organic substrates into H_2 by specific strains of anaerobic bacteria in the absence of light. However, H_2 production is affected by different factors that can decrease its productivity and make the process unstable.

In this work, the biomass activity on H_2 production of a mesophilic anaerobic inoculum from a municipal wastewater treatment plant was determined. Specific hydrolytic activity (SHA), specific acidogenic activity (SAA) and specific methanogenic activity (SMA) tests using cellulose, glucose and acetate, respectively, as substrates, were performed [2]. Different pre-treatments (heat (HP), acid (AcP) and alkaline (AkP)) have been applied to the inoculum to remove hydrogen-consuming bacteria. Moreover, not pretreated (NP) inoculum has been used as control. The effects of pH using a phosphate buffer solution and the substrate-inoculum ratio (SIR: 0.6-1.6) have been also studied. Finally, the H_2 production from a residual substrate consisting of a process water from hydrothermal carbonization of food waste (PW-FW) was evaluated under the previously optimized conditions.

MATERIALS AND METHODS

INOCULUM (MIXED CULTURE)

- NOT PRETREATED (NP)
- PRETREATED
  - HP: 100 ºC, 30 min
  - AcP: pH=3, 24 h
  - AkP: pH=10, 24 h

H_2, CH_4, CO_2

BATCH REACTOR

SUBSTRATE

- GLUCOSE — SAA
- CELLULOSE — SHA
- ACETATE — SMA
- PW-FW

NUTRIENT SOLUTION

RESULTS

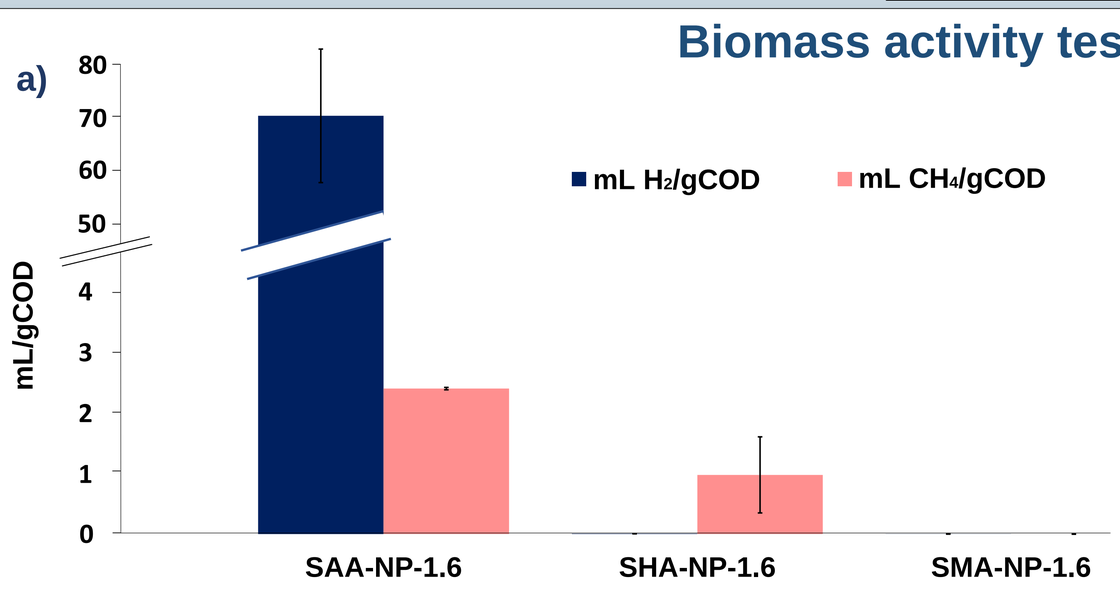

Figure 1. a) Total H_2 and methane production (mL/gCOD) on not pretreated (NP) biomass activity tests (SIR 1.6; pH_0: 5.5; Glucose, Cellulose and Acetate as substrates). b) Specific acidogenic activity test with pretreated inoculums (SIR 1.6; pH_0: 5.5; Glucose as substrate)

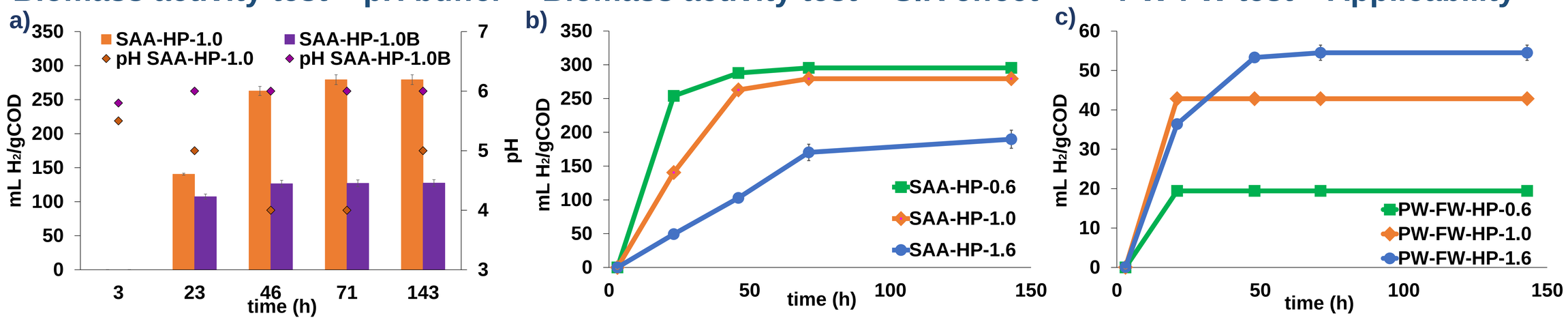

Figure 2. a) pH effect on cumulative H_2 production. (HP; SIR 1.0; Glucose as substrate; pH_0: 5.5 or phosphate buffer at pH 5.8). **b)** SIR effect on H_2 production (HP; pH_0: 5.5; Glucose as substrate). **c)** SIR effect on H_2 production using PW-FW as substrate (HP; pH_0: 5.5).

CONCLUSIONS

The selected inoculum showed an interesting acidogenic activity, which increased when the inoculum is subjected to heat pretreatment. In SAA tests, the highest hydrogen production is associated with the lowest SIR, not being interesting a control of pH using a buffer medium. A significative production of H_2 is also observed using a complex substrate, resulting the dark fermentation in a promising strategy to obtain H_2 from wastes.

References

[1] De la Rubia et al., Renewable Energy, 2018, 127, 697-704. [2] Burbano et al., International Journal of Environmental Science, 2019, 4, 66-72.

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