

TITLE: ANAEROBIC MONODIGESTION AND ANAEROBIC CO-DIGESTION OF SUGARCANE INDUSTRY RESIDUES WITH IRON SUPPLEMENTATION

AUTHORS: CALEGARI, R. P.¹; ŠAFARIČ, L.²; SHAKERI YEKTA, S.²; BJÖRN, A.²; ADIYA, P.²; HUANG, B.²; ALMEIDA, G. M. L. L.³; ARTHUR V.¹; BAPTISTA, A. S.³; ENRICH-PRAST, A.²

INSTITUTION: ¹Center for Nuclear Energy in Agriculture – University of São Paulo. Piracicaba – SP (Av. Centenário, 303, CEP 13400-970). ²Linköping University. Linköping – Sweden (Campus Valla, 581 83, Linköping). ³Luiz de Queiroz College of Agriculture – University of São Paulo. Piracicaba - SP (Av. Pádua Dias, 11, CEP 13418-900).

ABSTRACT

The sugarcane industry generates daily a large volume of residues with high polluting potential, such as vinasse (V), filter cake (F), and sugarcane straw (S). The present work aimed to evaluate the anaerobic monodigestion and anaerobic co-digestion of these residues and their supplementation with iron (Fe). A Biochemical Methane Potential test (BMP) was performed with 15 treatments with triplicates. The treatments were: F, F +Fe, FS, FS +Fe, S, S +Fe, V, V +Fe, VF, VF +Fe, VS, VS +Fe, VFS, VFS +Fe, and control (H₂O). The treatments with iron supplementation (+Fe) received 14g L⁻¹ of FeCl₃ (corresponding to a molar ratio of 1 S:Fe). The ratio of inoculum to the substrate was 2:1 based on Volatile Solids (VS). The experiment was incubated at 37 °C for 27 days (640 hours) in three AMPTS II systems (Bioprocess Control) with stirring every 15 minutes. The methane volume was measured continuously. The data were evaluated by fitting into the Gompertz model. The treatments with straw, filter cake, and combinations of straw, filter cake, and vinasse (S, S+Fe, F, F+Fe, FS, FS+Fe VS, VS+Fe, VFS, and VFS+Fe) showed lower slopes of the curves, which indicates slower degradation of the lignocellulosic-rich substrate. The treatments with the monodigestion of F and V showed better performance with the addition of iron (F+Fe: 68.61±7.24 and V+Fe: 312.48±11.18 Nml CH₄ g⁻¹ VS) when compared to the treatments without iron (F:57.37±6.47 and V:279.50±7.25 Nml CH₄ g⁻¹ VS). The performance was 16.38% and 10.55% higher for F+Fe and V+Fe, respectively. The best monodigestion treatment was V+Fe with 312.48±11.17 Nml CH₄ g⁻¹ VS, while the best substrate combination of co-digestion was VF with 286.96±25.15 Nml CH₄ g⁻¹ VS. The volatile fatty acids (VFA) (acetate, propionate, butyrate, isobutyrate, caproate, isocaproate, valerate, and isovalerate) were not detected in any sample at the end of the BMP test. Also, the pH of the samples at the end of the BMP ranged from 7.83 to 8.24. This indicates that there was no inhibition due to VFA accumulation. In conclusion, the iron supplementation was responsible for higher methane production and possibly avoided H₂S formation in the biogas, and provided better bioavailability of other trace elements to the microbial consortia.

Keywords: Biogas, sugarcane vinasse, filter cake, biochemical methane potential

Development Agency: This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - Brasil (CAPES) - Finance Code 001 and by the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq). This work was also supported by the Swedish Energy Agency through the Biogas Research Center (BRC) in Linköping [Grant number: 35624-2].