Bioenergy: Challenges and Opportunities
International Conference and Exhibition on Bioenergy
April 6th – 9th 2008
Universidade do Minho, Guimarães, Portugal

ANAEROBIC DIGESTION OF OILY WASTEWATER AS A VALUABLE SOURCE OF BIOENERGY

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ABSTRACT

Lipids are a group of organic pollutants whose conversion into biogas has been considered very difficult. During the anaerobic treatment of lipid-rich wastewater this conversion generally decreases with the increase of the organic loading rate (OLR) applied, due to long chain fatty acids (LCFA) accumulation. To overcome this problem, correct equilibrium between LCFA accumulation and degradation should be assured [1, 2, 3], and discontinuous operation was proposed by Pereira et al. [1] as a strategy to achieve an efficient rate of methane production. Based on these results, Cavaleiro et al. [4] studied the treatment of an oleate-rich effluent in an anaerobic reactor operated in cycles, with continuous feeding phases and batch reaction phases. The results obtained showed that continuous treatment was possible, with efficient conversion of LCFA to methane, after acclimation of the microbial consortium through discontinuous operation.

This work aimed the optimization of biogas production in a continuous reactor fed with an oleate-rich wastewater and inoculated with acclimated anaerobic sludge. Acclimation was performed through discontinuous operation in a lab scale reactor. During the experiment, the OLR applied was gradually increased from 5 to 31 kgCOD m^{-3} day^{-1}, by decreasing the hydraulic retention time. From 5 to 21 kgCOD m^{-3} day^{-1} the increase of the OLR was followed by a fast increase of the methane production rate, towards an average value that was directly related with the OLR, showing that there was no inhibition of the anaerobic consortium. However, when the OLR was increased to 26 kgCOD m^{-3} day^{-1}, methane production rate fluctuated around the same average value as in the previous period (16 kgCOD-CH_4 m^{-3} day^{-1}). For 31 kgCOD m^{-3} day^{-1}, methane production rate tended to decrease, possibly due to microbial inhibition or mass transfer limitations. From 21 to 31 kgCOD m^{-3} day^{-1} methane production rate was very instable, indicating that the OLR applied were higher than the optimum value for the microbial community. Maximum methane yield (100%) was obtained for the OLR of 12 kgCOD m^{-3} day^{-1}, but continuous anaerobic treatment of an OLR as high as 21 kgCOD m^{-3} day^{-1} was possible with a methane yield of 72% and average COD removal efficiency of 99%. Nevertheless, 16 kgCOD-CH_4 m^{-3} day^{-1} is likely the optimum OLR to be applied, in order to optimize methane production. Oily wastewater can be used as a valuable source of bioenergy by applying proper anaerobic digestion technology.

Keywords: biogas, LCFA, organic loading rate, anaerobic bioreactors

Theme: Biogas and Biohydrogen

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