TITLE: BIOGAS PRODUCTION FROM ANAEROBIC DIGESTION OF DAIRY WASTEWATER

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ABSTRACT:

Anaerobic digestion (AD) has become an attractive alternative for energy production, once it converts various types of organic wastes into biogas. In addition, AD is a mature technology that depends on a diverse microbial group synergistic effort for metabolizing various organic substrates. However, it is highly sensitive to process disturbances, therefore it is advantageous to use online monitoring and process control techniques to operate AD process efficiently. Thus, this study developed and used a lab made system to monitor/control some AD variables using the open source platform “Arduino” and its components. Then, the digestion of dairy wastewater inoculated with sewage sludge, which is one of the best sources of anaerobic bacteria, was evaluated in terms of biogas and methane yield, volatile solids (VS) removal rate and chemical oxygen demand (COD) removal. The batch experiment was conducted in an anaerobic stirred tank batch reactor (AnSTBR) of 2 L, where it was inserted the inoculum/substrate in a ratio of 1:2, at mesophilic conditions (38 ± 2 ^{o}C), with automatically pH adjustment to 6.5 - 7.8, as ideal condition for methanogenic bacteria, during 21 days. On the first day of digestion, a peak of biogas production was observed, followed by no biogas production from day 3 to 12, indicating a severe inhibition likely caused by dairy wastewater oily nature which resulted in acid overproduction and inhibited the methanogenic bacteria. Nonetheless, aiming to avoid a pH larger decrease, 1M NaOH was used as alkali solution utilized for stabilizing the pH, which at day 12 reached the ideal range and allowed the methane production. In the end, the average cumulative biogas and methane concentration in this condition was 675.2 mL and 21.64%, respectively, and the VS and COD removal rate was 45.35% and 80.1%, respectively. Finally, an ecotoxicity test using lettuce seeds (*Lactuca sativa*) was carried out to evaluate the AD residue (digestate) and showed that high digestate concentrations exhibited toxicity in comparison to the control sample. Thus, it was observed that the pH controlling was essential to allow the methanogenesis step, and consequently the methane production.

Keywords: anaerobic digestion, online monitoring, biogas production, ecotoxicity

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