Co-digestion of palm oil mill effluent for enhanced biogas production in a solar assisted bioreactor: Supplementation with ammonium bicarbonate

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ABSTRACT

Lack of sufficient nitrogenous substrate and buffering potential have been acknowledged as impediments to the treatment of palm oil mill effluent through co-digestion processes. In this study, ammonium bicarbonate was used to provide the nitrogenous substrate and buffering potential. To regulate the impact of ammonium bicarbonate toxicity on the anaerobic co-digestion system, dosages from 0 to 40 mg/L were supplemented. The biogas yield was used to indicate the effects of NH4+ toxicity. In a solar-assisted bioreactor, solar radiation was first collected by a solar panel and converted into electricity, which was then used to heat a mixture of palm oil mill effluent and cattle manure to maintain the reactor in the mesophilic temperature range. This co-digestion operation was performed semi-continuously and was analyzed at a 50:50 mixing ratio of palm oil mill effluent and cattle manure. The results indicate that the additional dosing of ammonium bicarbonate can significantly enhance biogas production. Maximum cumulative biogas and methane productions of 2034.00 mL and 1430.51 mL, respectively, were obtained with the optimum addition of 10 mg/L ammonium bicarbonate; these values are 29.80% and 42.30% higher, respectively, than that obtained in the control co-digestion operation without addition of ammonium bicarbonate. Utilization of a mathematical equation ($G = Gmk/t$) to describe a kinetic analysis of the biogas yield also indicated that the optimum ammonium bicarbonate dose was 10 mg/L. The results of this study suggest that supplementation with ammonium bicarbonate doses of up to 40 mg/L can be used to provide nitrogenous substrates and buffering potential in anaerobic co-digestion processes. The determination of the optimal dose provides an alternative and efficient option for

enhanced biogas production, which will have obvious economic advantages for feasible industrial applications..

KEYWORDS

Ammonium bicarbonate; Solar-assisted bioreactor; Anaerobic co-digestion; Palm oil mill effluent; Cattle manure; Biogas production

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