

Effect of cod loading rate on an upflow anaerobic sludge blanket reactor during anaerobic digestion of palm oil mill effluent with butyrate

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ABSTRACT

Palm oil Mill Effluent (POME) with concentrated butyrate was treated in a 4.5 l upflow anaerobic sludge blanket reactor (UASBR), run over a range of influent concentrations (16.5–46.0 g-COD l⁻¹), chemical oxygen demand (COD) loading rates (1.5–11.5 g-COD l⁻¹d⁻¹) and 11–4 days hydraulic retention time (HRT) at 37 °C by maintaining pH between 6.5–7.5. The process consistently removed 97–99% of COD at loading rates up to 1.5–4.8 g-COD l⁻¹d⁻¹ by varying HRT (11–7.2 days). Butyrate is an important intermediate in the anaerobic degradation of organic matter. In sulphate-depleted environment, butyrate in POME (BOD/COD ratio of 0.5) is β-oxidised to acetate and hydrogen, by obligate proton reducers in syntrophic association with hydrogen utilizing methanogens. The conversion of acetate to methane appeared to be rate limiting step. Maximum biogas (20.17 l l⁻¹d⁻¹) and methane production (16.2 l l⁻¹d⁻¹) were obtained at COD loading rate of 4.80 g l⁻¹d⁻¹ and HRT of 7.2 days. The biogas and methane production were higher in the presence of butyrate compared to control. The methane content of the biogas was in the range of 70–80% throughout the study while in control it was 60–65%. Finding of this study clearly indicates the successful treatment of POME with butyrate in UASBR.

KEYWORDS:

Acetate; Anaerobic degradation; Butyrate; Palm oil mill effluent; UASB reactor

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