Accelerated two-stage bioprocess for hydrogen and methane production from palm oil mill effluent using continuous stirred tank reactor and microbial electrolysis cell

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ABSTRACT

This paper investigates the production of hydrogen (H_2) and methane (CH_4) from palm oil mill effluent (POME) using an integrated approach of thermophilic continuous stirred tank reactor (CSTR) and mesophilic microbial electrolysis cell (MECs). CSTR reactor was operated at pH 5.5, 80 rpm, 2 days HRT, 60 g COD L^{-1} d^{-1} organic loading rate (OLR) and 55 °C temperature with the given hydrogen yield of 205 ml H_2 $gCOD^{-1}$along with acetic, butyric, propionic, and lactic acid as by-products. Continuous, single-chambered MECs fed with dark fermentation effluents were operated at an applied voltage of 0.5 V at 37 °C to obtain methane yield and production rate (MPR) of 290 ml CH_4 $gCOD^{-1}$ and 2700 ml CH_4 L^{-1} at 8 days of hydraulic retention times (HRT). The overall process led to total energy recovery of 92.72% with 91% COD removal efficiency. Microbial community analysis reveals *Thermoanerobacterium* sp dominated in CSTR whereas exoelectrogens of *Methanobacterium formicicum* and *Methanobacterium beijingense* were found to be the chief dominant microbial species on anodic electrode of MECs.

KEYWORDS

Palm oil mill effluent; Bio-hydrogen; Biomethane; Microbial electrolysis cell; Dark fermentation

ACKNOWLEDGMENTS

Authors would like to thank Universiti Teknologi Malaysia and AUN/SEED-Net and JICA for the financial support. This work was supported by PDRU Grant- Vot
No. Q.J130000.21A2.04E53, Collaborative Research (CR) Grant,
Vote: R.J130000.7317.4B194, Collaborative Research Program for Common Regional Issues (CRC) Grant, Vote: R.J130000.7317.4B189 and UTM Matching Grant,
Vote: Q.J130000.3017.00M90.