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Effect of temperature and hydraulic retention time on hydrogen production from palm oil mill effluent (POME) in an integrated up-flow anaerobic sludge fixed-film (UASFF) bioreactor

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ABSTRACT

The current state of palm oil mill wastewater treatment focuses solely on open ponding or closed lagoon systems for biogas production. However, efforts to convert this wastewater into biohydrogen are limited. Therefore, this research investigates the feasibility of converting palm oil mill effluent (POME) for biohydrogen production via dark fermentation. Temperature and hydraulic retention time (HRT) effects on biohydrogen production and COD removal efficiency in an up-flow anaerobic sludge fixed-film (UASFF) bioreactor were investigated. The experiment was carried out and analysed using a central composite design (CCD) and the Response Surface Methodology (RSM). The hydrogen (H_2) yield, H_2 production rate (HPR), and COD removal efficiency were investigated as responses. HPR increased significantly by 28.8 folds as temperature increased from 37 °C to 53.5 °C (transition from mesophilic to thermophilic) at HRT of 3 h. Meanwhile, the COD removal efficiency significantly increased from 24.76% to 33.33% between 4 to 9 h of HRT. Maximum H_2 yield of 0.95 L H_2 g^{-1} $COD_{removed}$, HPR of 10.39 L H_2 d^{-1}, and 35.9% COD removal were reported at the optimum HRT and temperature of 7 h and 57 °C, respectively. This study indicates that under the thermophilic condition and short HRT, POME could be treated while producing biohydrogen using the UASFF bioreactor.

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