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Application of polyethylene glycol immobilized *Clostridium* sp. LS2 for continuous hydrogen production from palm oil mill effluent in upflow anaerobic sludge blanket reactor

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ABSTRACT

A novel polyethylene glycol (PEG) gel was fabricated and used as a carrier to immobilize *Clostridium* sp. LS2 for continuous hydrogen production in an upflow anaerobic sludge blanket (UASB) reactor. Palm oil mill effluent (POME) was used as the substrate carbon source. The optimal amount of PEG-immobilized cells for anaerobic hydrogen production was 12% (w/v) in the UASB reactor. The UASB reactor containing immobilized cells was operated at varying hydraulic retention times (HRT) that ranged from 24 to 6 h at 3.3 g chemical oxygen demand (COD)/L/h organic loading rate (OLR), or at OLRs that ranged from 1.6 to 6.6 at 12 h HRT. The best volumetric hydrogen production rate of 336 mL H_2/L/h (or 15.0 mmol/L/h) with a hydrogen yield of 0.35 L H_2/g $COD_{removed}$ was obtained at a HRT of 12 h and an OLR of 5.0 g COD/L/h. The average hydrogen content of biogas and COD reduction were 52% and 62%, respectively. The major soluble metabolites during hydrogen fermentation were butyric acid followed by acetic acid. It is concluded that the PEG-immobilized cell system developed in this work has great potential for continuous hydrogen production from real wastewater (POME) using the UASB reactor.

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