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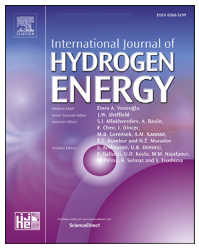

Start-up study of biohydrogen production from palm oil mill effluent in a lab-scale up-flow anaerobic sludge blanket fixed-film reactor

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HIGHLIGHTS

- Fermentative hydrogen production from palm oil mill effluent.
- Substrate particle size, surface morphology, elemental identification were studied.
- Maximum H_2 production at HRT 8 h/OLR 45.4 g COD L^{-1} day^{-1}.
- Evolution in microbial community before and after dark fermentation.
- *Clostridium sensu stricto* 1 mostly contributed to biohydrogen production.

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ABSTRACT

A start-up study of lab-scale up-flow anaerobic sludge blanket fixed-film reactor (UASFF) was conducted to produce biohydrogen from palm oil mill effluent (POME). The reactor was fed with POME at different hydraulic retention time (HRT) and organic loading rate (OLR) to obtain the optimum fermentation time for maximum hydrogen yield (HY). The results showed the HY, volumetric hydrogen production rate (VHPR), and COD removal of 0.5–1.1 L H_2/g $COD_{consumed}$, 1.98–4.1 L H_2 L^{-1} day^{-1}, and 33.4–38.5%, respectively. The characteristic study on POME particles was analyzed by particle size distribution (PSD), Scanning electron microscopy (SEM), and Energy-dispersive X-ray spectroscopy (EDX). The microbial Shannon and Simpson diversity indices and Principal Component Analysis assessed the alpha and beta diversity, respectively. The results indicated the change of bacterial community diversity over the operation, in which *Clostridium sensu stricto* 1 and *Lactobacillus* species were contributed to hydrogen fermentation.

Introduction

International Energy Agency (IEA) conveyed that fossil-based fuels fulfil significant energy demands of the world [1]. Due to the fast growth of the population, and industrial development, more energy requirement is anticipated, which has been estimated at 83% by 2030 [1,2]. Concerning the fossil fuels exhaustion, and greenhouse gases (GHGs) emission, such as carbon dioxide (CO_2) and carbon monoxide (CO), the severe problem of environmental distress and global warming

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