

Free Full Text from Publisher [Look Up Full Text](#) Full Text from Publisher [Find PDF](#) [Export...](#) [Add to Marked List](#)

## Thermophilic biohydrogen production from palm oil mill effluent: Effect of immobilized cells on granular activated carbon in fluidized bed reactor

By: [Jamali, NS](#) (Jamali, Nur Syakina)<sup>[1]</sup>; [Rashidi, NFD](#) (Rashidi, Nur Farahana Dzul)<sup>[1]</sup>; [Jahim, JM](#) (Jahim, Jamaliah Md)<sup>[2]</sup>; [O-Thong, S](#) (O-Thong, Sompong)<sup>[3]</sup>; [Jehlee, A](#) (Jehlee, Aminee)<sup>[3]</sup>; [Engliman, NS](#) (Engliman, Nurul Sakinah)<sup>[4]</sup>

### FOOD AND BIOPRODUCTS PROCESSING

Volume: 117 Pages: 231-240

DOI: 10.1016/j.fbp.2019.07.012

Published: SEP 2019

Document Type: Article

[View Journal Impact](#)

### Abstract

In this study, the performance of immobilized cells on granular activated carbon (GAC) for thermophilic biohydrogen production is determined using POME as a fermentation substrate. The immobilized cells are formed at different pH medium using sugar composition characterized in the POME. The pH 6 revealed the optimum pH used for biofilm development with HPR of 2.8 mmol H<sub>2</sub>/L h. The effect of sugar utilization by the immobilized cells on GAC are determined at different sugar concentration using the Monod model prior validated the performance of the cells in the fluidized bed reactor (FBR). From the model, 0.316 +/- 0.013 h<sup>-1</sup> of maximum specific growth rate was obtained at 20 g/L sugar used and was keep increasing to the maximum of 30 g/L of sugar used with HPR 2.6-2.8 mmol H<sub>2</sub>/L h. Lastly, the POME-enriched nutrients are used as the carbon source in the fluidized bed reactor (FBR). The highest HPR obtained was at HRT 12 h, (5.2 mmol H<sub>2</sub>/L h) and HY of 1.24 mol H<sub>2</sub>/mol sugar. The screening of the microbial population by DGGE revealed that the Thermoanaerobacterium thermosaccharolyticum sp. was dominant for all the HRTs, thereby indicating that this bacterium is resilient towards environmental disturbances. (C) 2019 Institution of Chemical Engineers. Published by Elsevier B.V. All rights reserved.

### Keywords

**Author Keywords:** Biohydrogen production; Immobilized cells; Activated carbon; Palm oil mill effluent; Fluidized bed reactor

**KeyWords Plus:** CONTINUOUS HYDROGEN-PRODUCTION; BACTERIAL COMMUNITY; THERMOANAEROBACTERIUM-THERMOSACCHAROLYTICUM; BIOFILM FORMATION; SLUDGE; GLUCOSE; WASTE

### Author Information

**Reprint Address:** Jamali, NS (reprint author)

+ Univ Putra Malaysia, Fac Engn, Dept Chem & Environm Engr, Serdang 43400, Selangor Darul, Malaysia.

### Addresses:

+ [ 1 ] Univ Putra Malaysia, Fac Engn, Dept Chem & Environm Engr, Serdang 43400, Selangor Darul, Malaysia

+ [ 2 ] Univ Kebangsaan Malaysia, Dept Chem & Proc Engr, Ukm Bangi 43600, Selangor, Malaysia

[ 3 ] Thaksin Univ, Fac Sci, Res Ctr Energy & Environm, Phatthalung 93210, Thailand

+ [ 4 ] IUM, Kulliyah Engr, Dept Biotechnol Biochem Engr, POB 10, Kuala Lumpur 50728, Malaysia

**E-mail Addresses:** [syakina@upm.edu.my](mailto:syakina@upm.edu.my)

### Funding

Funding Agency	Grant Number
Sime Darby Plantation, Sdn Bhd, Malaysia under the Zero Waste Technology program specifically Trust Area Biohydrogen	KK-2015-002
Grant Putralnisiatif Putra Muda (GP-IPM, 2018)	

[View funding text](#)

### Publisher

ELSEVIER, RADARWEG 29, 1043 NX AMSTERDAM, NETHERLANDS

### Journal Information

**Impact Factor:** [Journal Citation Reports](#)

### Categories / Classification

**Research Areas:** Biotechnology & Applied Microbiology; Engineering; Food Science & Technology

**Web of Science Categories:** Biotechnology & Applied Microbiology; Engineering, Chemical; Food Science & Technology

[See more data fields](#)

### Citation Network

In Web of Science Core Collection

**1**

Times Cited

[Create Citation Alert](#)

### All Times Cited Counts

1 in All Databases

[See more counts](#)

**24**

Cited References

[View Related Records](#)

### Most recently cited by:

Wang, Jianfei; Huang, Jiaqi; Guo, Huanyu; et al.  
[Optimization of immobilization conditions for Lactobacillus pentosus cells. BIOPROCESS AND BIOSYSTEMS ENGINEERING \(2020\)](#)

[View All](#)

### Use in Web of Science

Web of Science Usage Count

**2**

Last 180 Days

**2**

Since 2013

[Learn more](#)

### This record is from:

Web of Science Core Collection  
- Science Citation Index Expanded

### Suggest a correction

*If you would like to improve the quality of the data in this record, please [suggest a correction](#).*

---

## Cited References: 24

Showing 24 of 24 [View All in Cited References page](#)

(from Web of Science Core Collection)

---

1. **Effect of column's temperature and evaluation of RID and ELSD as suitable ion exchange HPLC detection method of simple sugars** Times Cited: 5  
By: Abdul, P; Harun, S; Jahim, J. M; et al.  
J. Sci. Technol. Pages: 599-604 Published: 2011  
[\[Show additional data\]](#)
2. **Overview of hydrogen production technologies from biogas and the applications in fuel cells** Times Cited: 165  
By: Alves, Helton Jose; Bley Junior, Cicero; Niklevicz, Rafael Rick; et al.  
INTERNATIONAL JOURNAL OF HYDROGEN ENERGY Volume: 38 Issue: 13 Pages: 5215-5225 Published: MAY 1 2013
3. **Anaerobic biofilm reactors for dark fermentative hydrogen production from wastewater: A review** Times Cited: 48  
By: Barca, Cristian; Soric, Audrey; Ranava, David; et al.  
BIORESOURCE TECHNOLOGY Volume: 185 Pages: 386-398 Published: JUN 2015
4. **Isolation of a new Thermoanaerobacterium thermosaccharolyticum strain (FH1) producing a thermostable dextranase** Times Cited: 26  
By: Hoster, F; Daniel, R; Gottschalk, G  
JOURNAL OF GENERAL AND APPLIED MICROBIOLOGY Volume: 47 Issue: 4 Pages: 187-192 Published: AUG 2001
5. **Optimization of thermophilic biohydrogen production by microflora of palm oil mill effluent: cell attachment on granular activated carbon as support media** Times Cited: 2  
By: Jamali, NS; Jahim, J Md.  
Malays J Anal Sci Volume: 20 Pages: 1437-46 Published: 2016
6. **Particle size variations of activated carbon on biofilm formation in thermophilic biohydrogen production from palm oil mill effluent** Times Cited: 10  
By: Jamali, Nur Syakina; Jahim, Jamaliah Md; Isahak, Wan Nor Roslam Wan; et al.  
ENERGY CONVERSION AND MANAGEMENT Volume: 141 Special Issue: SI Pages: 354-366 Published: JUN 1 2017
7. **Hydrodynamic characteristics and model of fluidized bed reactor with immobilised cells on activated carbon for biohydrogen production** Times Cited: 2  
By: Jamali, Nur Syakina; Jahim, Jamaliah Md; O-Thong, Sompong; et al.  
INTERNATIONAL JOURNAL OF HYDROGEN ENERGY Volume: 44 Issue: 18 Pages: 9256-9271 Published: APR 5 2019
8. **Biofilm formation on granular activated carbon in xylose and glucose mixture for thermophilic biohydrogen production** Times Cited: 20  
By: Jamali, Nur Syakina; Jahim, Jamaliah Md; Isahak, Wan Nor Roslam Wan  
INTERNATIONAL JOURNAL OF HYDROGEN ENERGY Volume: 41 Issue: 46 Pages: 21617-21627 Published: DEC 14 2016
9. **Physicochemical characteristics of attached biofilm on granular activated carbon for thermophilic biohydrogen production** Times Cited: 15  
By: Lutpi, Nabilah Aminah; Jahim, Jamaliah Md; Mumtaz, Tabassum; et al.  
RSC ADVANCES Volume: 5 Issue: 25 Pages: 19382-19392 Published: 2015
10. **Pretreatment conditions of palm oil mill effluent (POME) for thermophilic biohydrogen production by mixed culture** Times Cited: 9  
By: Mahmud, Safa Senan; Jahim, Jamaliah Md; Abdul, Peer Mohamed  
INTERNATIONAL JOURNAL OF HYDROGEN ENERGY Volume: 42 Issue: 45 Special Issue: SI Pages: 27512-27522 Published: NOV 9 2017
11. **The Ribosomal Database Project (RDP)** Times Cited: 454  
By: Maidak, BL; Olsen, GJ; Larsen, N; et al.  
NUCLEIC ACIDS RESEARCH Volume: 24 Issue: 1 Pages: 82-85 Published: JAN 1 1996
12. **Biorefineries and the food, energy, water nexus - towards a whole systems approach to design and planning** Times Cited: 21  
By: Martinez-Hernandez, Elias; Samsatli, Sheila  
CURRENT OPINION IN CHEMICAL ENGINEERING Volume: 18 Pages: 16-22 Published: NOV 2017
13. **Acidogenic fermentation of vegetable based market waste to harness biohydrogen with simultaneous stabilization** Times Cited: 68  
By: Mohan, S. Venkata; Mohanakrishna, G.; Goud, R. Kannaiah; et al.  
BIORESOURCE TECHNOLOGY Volume: 100 Issue: 12 Pages: 3061-3068 Published: JUN 2009
14. **Influence of support materials on continuous hydrogen production in anaerobic packed-bed reactor with immobilized hydrogen producing bacteria at acidic conditions** Times Cited: 12  
By: Muri, Petra; Marinsek-Logar, Romana; Djinovic, Petar; et al.  
ENZYME AND MICROBIAL TECHNOLOGY Volume: 111 Pages: 87-96 Published: APR 2018
15. **16S rRNA-targeted probes for specific detection of Thermoanaerobacterium spp., Thermoanaerobacterium thermosaccharolyticum, and Caldicellulosiruptor spp. by fluorescent in situ hybridization in biohydrogen producing systems** Times Cited: 20  
By: O-Thong, Sompony; Prasertsan, Poonsuk; Karakashev, Dimitar; et al.  
INTERNATIONAL JOURNAL OF HYDROGEN ENERGY Volume: 33 Issue: 21 Pages: 6082-6091 Published: NOV 2008

16. **A Recent Overview of Palm Oil Mill Effluent Management via Bioreactor Configurations** Times Cited: 9  
By: Rana, Supriyanka; Singh, Lakhveer; Wahid, Zularisam; et al.  
CURRENT POLLUTION REPORTS Volume: 3 Issue: 4 Pages: 254-267 Published: DEC 2017
17. **Batch Fermentative Biohydrogen Production Process Using Immobilized Anaerobic Sludge from Organic Solid Waste** Times Cited: 6  
By: Sekoai, Patrick T.; Yoro, Kelvin O.; Daramola, Michael O.  
ENVIRONMENTS Volume: 3 Issue: 4 Article Number: 38 Published: DEC 2016
18. **Microbial cell immobilization in biohydrogen production: a short overview** Times Cited: 13  
By: Sekoai, Patrick Thabang; Awosusi, Ayotunde A.; Yoro, Kelvin Odafe; et al.  
CRITICAL REVIEWS IN BIOTECHNOLOGY Volume: 38 Issue: 2 Pages: 157-171 Published: 2018
19. **Application of polyethylene glycol immobilized Clostridium sp LS2 for continuous hydrogen production from palm oil mill effluent in upflow anaerobic sludge blanket reactor** Times Cited: 43  
By: Singh, Lakhveer; Siddiqui, Muhammad Faisal; Ahmad, Anwar; et al.  
BIOCHEMICAL ENGINEERING JOURNAL Volume: 70 Pages: 158-165 Published: JAN 15 2013
20. **Methods for enhancing bio-hydrogen production from biological process: A review** Times Cited: 88  
By: Singh, Lakhveer; Wahid, Zularisam A.  
JOURNAL OF INDUSTRIAL AND ENGINEERING CHEMISTRY Volume: 21 Pages: 70-80 Published: JAN 25 2015
21. **Changes in bacterial community during fermentative hydrogen and acid production from organic waste by thermophilic anaerobic microflora** Times Cited: 71  
By: Ueno, Y.; Sasaki, D.; Fukui, H.; et al.  
JOURNAL OF APPLIED MICROBIOLOGY Volume: 101 Issue: 2 Pages: 331-343 Published: AUG 2006
22. **HRT-dependent hydrogen production and bacterial community structure of mixed anaerobic microflora in suspended, granular and immobilized sludge systems using glucose as the carbon substrate** Times Cited: 79  
By: Wu, Shu-Yii; Hung, Chun-Hsiung; Lin, Chiu-Yue; et al.  
INTERNATIONAL JOURNAL OF HYDROGEN ENERGY Volume: 33 Issue: 5 Pages: 1542-1549 Published: MAR 2008
23. **EXPRESSION OF SOLVENT-FORMING ENZYMES AND ONSET OF SOLVENT PRODUCTION IN BATCH CULTURES OF CLOSTRIDIUM-BEIJERINCKII (CLOSTRIDIUM-BUTYLICUM)** Times Cited: 66  
By: YAN, RT; ZHU, CX; GOLEMBOSKI, C; et al.  
APPLIED AND ENVIRONMENTAL MICROBIOLOGY Volume: 54 Issue: 3 Pages: 642-648 Published: MAR 1988
24. **Succession of bacterial community and enzymatic activities of activated sludge by heat-treatment for reduction of excess sludge** Times Cited: 85  
By: Yan, Sangtian; Miyanaga, Kazuhiko; Xing, Xin-Hui; et al.  
BIOCHEMICAL ENGINEERING JOURNAL Volume: 39 Issue: 3 Pages: 598-603 Published: MAY 1 2008

Showing 24 of 24 [View All in Cited References page](#)

