Innovative self-powered submersible microbial electrolysis cell (SMEC) for biohydrogen production from anaerobic reactors

A self-powered submersible microbial electrolysis cell (SMEC), in which a specially designed anode chamber and external electricity supply were not needed, was developed for in situ biohydrogen production from anaerobic reactors. In batch experiments, the hydrogen production rate reached 17.8 mL/L/d at the initial acetate concentration of 410 mg/L (5 mM), while the cathodic hydrogen recovery (RH2) and overall systemic coulombic efficiency (CEos) were 93% and 28%, respectively, and the systemic hydrogen yield (YH2) peaked at 1.27 mol-H2/mol-acetate. The hydrogen production increased along with acetate and buffer concentration. The highest hydrogen production rate of 32.2 mL/L/d and YH2 of 1.43 mol-H2/mol-acetate were achieved at 1640 mg/L (20 mM) acetate and 100 mM phosphate buffer. Further evaluation of the reactor under single electricity-generating or hydrogen-producing mode indicated that further improvement of voltage output and reduction of electron losses were essential for efficient hydrogen generation. In addition, alternate exchanging the electricity-assisting and hydrogen-producing function between the two cell units of the SMEC was found to be an effective approach to inhibit methanogens. Furthermore, 16S rRNA genes analysis showed that this special operation strategy resulted same microbial community structures in the anodic biofilms of the two cell units. The simple, compact and in situ applicable SMEC offers new opportunities for reactor design for a microbial electricity-assisted biohydrogen production system.

General information
State: Published
Organisations: Department of Environmental Engineering, Residual Resource Engineering
Contributors: Zhang, Y., Angelidaki, I.
Pages: 2727-2736
Publication date: 2012
Peer-reviewed: Yes

Publication information
Journal: Water Research
Volume: 46
Issue number: 8
ISSN (Print): 0043-1354
Ratings:
BFI (2019): BFI-level 2
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 7.55 SJR 2.601 SNIP 2.358
Web of Science (2017): Impact factor 7.051
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 7.49 SJR 2.663 SNIP 2.563
Web of Science (2016): Impact factor 6.942
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 6.63 SJR 2.665 SNIP 2.482
Web of Science (2015): Impact factor 5.991
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 6.13 SJR 2.946 SNIP 2.702
Web of Science (2014): Impact factor 5.528
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): CiteScore 6.02 SJR 2.956 SNIP 2.676
Web of Science (2013): Impact factor 5.323
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2