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A new degassing membrane coupled upflow anaerobic sludge blanket (UASB) reactor to achieve in-situ biogas upgrading and recovery of dissolved CH4 from the anaerobic effluent

A new technology for in-situ biogas upgrading and recovery of CH4 from the effluent of biogas reactors was proposed and demonstrated in this study. A vacuum degassing membrane module was used to desorb CO2 from the liquid phase of a biogas reactor. The degassing membrane was submerged into a degassing unit (DU). The results from batch experiments showed that mixing intensity, transmembrane pressure, pH and inorganic carbon concentration affected the CO2 desorption rate in the DU. Then, the DU was directly connected to an upflow anaerobic sludge blanket (UASB) reactor. The results showed the CH4 content was only 51.7% without desorption of CO2, while it increased when the liquid of UASB was recycled through the DU. The CH4 content increased to 71.6%, 90%, and 94% with liquid recirculation rate through the DU of 0.21, 0.42 and 0.63L/h, respectively. The loss of methane due to dissolution in the effluent was reduced by directly pumping the reactor effluent through the DU. In this way, the dissolved CH4 concentration in the effluent decreased from higher than 0.94mM to around 0.13mM, and thus efficient recovery of CH4 from the anaerobic effluent was achieved. In the whole operational period, the COD removal efficiency and CH4 yield were not obviously affected by the gas desorption.

General information
Publication status: Published
Organisations: Department of Environmental Engineering, Residual Resource Engineering, Fudan University, Beijing University of Chemical Technology
Contributors: Luo, G., Wang, W., Angelidaki, I.
Number of pages: 7
Pages: 536-542
Publication date: 2014
Peer-reviewed: Yes

Publication information
Journal: Applied Energy
Volume: 132
ISSN (Print): 0306-2619
Ratings:
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 6.93 SJR 3.158 SNIP 3.212
Web of Science (2014): Impact factor 5.613
Web of Science (2014): Indexed yes
Original language: English
Keywords: In-situ biogas upgrading, Recovery of CH4, UASB, Degassing membrane
DOIs: 10.1016/j.apenergy.2014.07.059
Source: FindIt
Source ID: 269737418
Research output: Contribution to journal › Journal article – Annual report year: 2014 › Research › peer-review