Hybrid biogas upgrading in a two-stage thermophilic reactor

The aim of this study is to propose a hybrid biogas upgrading configuration composed of two-stage thermophilic reactors. Hydrogen is directly injected in the first stage reactor. The output gas from the first reactor (in-situ biogas upgrade) is subsequently transferred to a second upflow reactor (ex-situ upgrade), in which enriched hydrogenotrophic culture is responsible for the hydrogenation of carbon dioxide to methane. The overall objective of the work was to perform an initial methane enrichment in the in-situ reactor, avoiding deterioration of the process due to elevated pH levels, and subsequently, to complete the biogas upgrading process in the ex-situ chamber. The methane content in the first stage reactor reached on average 87% and the corresponding value in the second stage was 91%, with a maximum of 95%. A remarkable accumulation of volatile fatty acids was observed in the first reactor (in-situ) after 8 days of continuous hydrogen injection reaching a concentration of 5.6 g/L. Nevertheless, after an adaptation period, the system managed to recover and the volatile fatty acids decreased to 2.5 g/L. No pH drop was recorded during the period characterised by increased volatile fatty acids concentration mainly due to the consumption of the endogenous carbon dioxide by hydrogenotrophic methanogens. The effect of hydrogen injection on the microbial community in both reactors was analysed by 16S rRNA gene amplicon sequencing. The results demonstrated an increment in relative abundance of hydrogenotrophic methanogens and homoacetogens in the in-situ reactor, while the microbial community in the ex-situ chamber was simpler and dominated by hydrogenotrophic methanogens.

General information
Publication status: Published
Organisations: Department of Environmental Engineering, Residual Resource Engineering, Polytechnic University of Milan
Corresponding author: Kougias, P.
Pages: 1-10
Publication date: 2018
Peer-reviewed: Yes

Publication information
Journal: Energy Conversion and Management
Volume: 168
ISSN (Print): 0196-8904
Ratings:
BFI (2018): BFI-level 1
Scopus rating (2018): CiteScore 7.87 SJR 2.73 SNIP 2.151
Web of Science (2018): Impact factor 7.181
Web of Science (2018): Indexed yes
Original language: English
Keywords: Biological Materials, Biology, Gas Fuels, Chemical Products Generally, Anaerobic digestion, Biogas upgrading, Hybrid configuration, Hydrogenotrophic methanogenesis, Power to gas, Biogas, Carbon dioxide, Fuel injection, Hydrogen, Methane, Methanogens, RNA, Hybrid configurations, Hydrogenotrophic methanogens, Methane enrichments, Microbial communities, Thermophilic reactors, Volatile fatty acids
DOIs:
10.1016/j.enconman.2018.04.074
Source: FindIt
Source-ID: 2434241583
Research output: Contribution to journal › Journal article – Annual report year: 2018 › Research › peer-review