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Published in:
Book of Abstracts Sustain 2017

Publication date:
2017

Document Version
Publisher's PDF, also known as Version of record

Acclimation of ammonia tolerant methanogenic consortia using different bioreactor types

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Ammonia is the most common inhibitor of anaerobic digestion (AD) process, triggering suboptimal exploitation of the biogas potential of the feedstocks, resulting to significant economic losses for the biogas plants (Fotidis et al., 2013). Bioaugmentation with ammonia tolerant methanogens was proposed as a solution to overcome ammonia inhibition. However, there is still the need to establish appropriate technologies to generate ammonia tolerant methanogens. In the current study, three reactor types (i.e. batch, fed-batch and continuous stirred-tank reactors (CSTR)) operated at mesophilic (37°C) and thermophilic (55°C) conditions, were assessed as means for generation of acclimatized ammonia tolerant methanogens. The technologies were evaluated based on their methane production efficiency, incubation time and final TAN/FAN (total ammonium nitrogen/free ammonia nitrogen) levels. Overall, fed-batch cultivation was clearly the most efficient acclimation method compared to batch and CSTR methods. Specifically, by saving incubation time up to 150% (or up to 94 days), fed-batch reactors were acclimatized to nearly twofold higher FAN levels (549 and 1633 mg NH_3-N L^{-1} for mesophilic and thermophilic conditions, respectively) compared to batch method, with the same efficiency (>83%). At the same time, CSTR reactors were inhibited at lower ammonia levels (< 4.6 g NH_4^+-N L^{-1}) reaching only 30% of the theoretical production. The reduced growth rate of the microorganism, caused by ammonia toxicity, led to their washout. The higher performance of the fed-batch compared with CSTR and batch reactors is attributed to: the absence of washout for the former and the relatively stable microorganism growth for the latest (Fynn & Whitmore, 1984). In fed-batch in fact, the growth is controlled by the exponential feeding strategy (Ding & Tan, 2006).

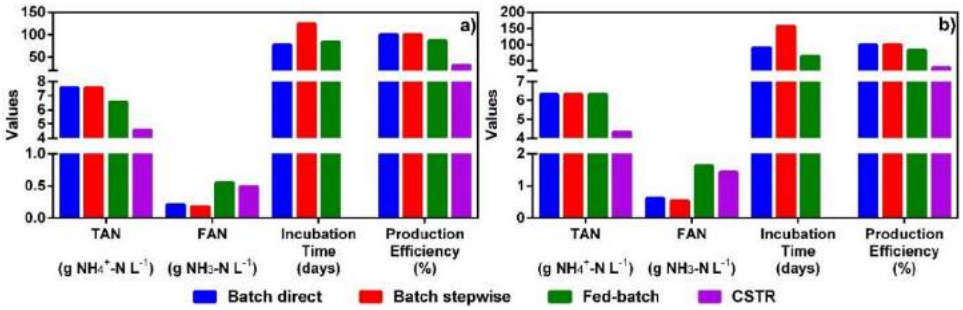

Figure 1. The acclimation methods for a) mesophilic and b) thermophilic inocula

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