Hydrogenotrophic activity under increased H_2/CO_2 pressure: Effect on methane production and microbial community

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H_2 and CO_2 are main compounds of synthesis gas. Efficient conversion of syngas to biomethane is a straightforward strategy to integrate the energy value of syngas into existing natural gas grid infrastructures. In this study, the effect of initial H_2/CO_2 (80/20, v/v) pressure on methane production rate and microbial community diversity was assessed in a hyperbaric bioreactor inoculated with anaerobic granular sludge.

Several batch experiments were performed to distinguish between the effect of initial total gas pressure and H_2/CO_2 partial pressure: (1) varying initial gas pressure (from 1 to 6 bar) with 100% H_2/CO_2 mixture; (2) constant initial gas pressure (5 bar), with increasing H_2/CO_2 partial pressure (from 1 to 5 bar); (3) varying initial gas pressure (from 2 to 5 bar) with constant H_2/CO_2 partial pressure (2 bar). In (2) and (3), N_2 was used for ensuring the necessary overpressure. Microbial community changes in the system were monitored by 16S rRNA-based techniques (PCR-DGGE).

The raise of H_2/CO_2 initial pressure (100% H_2/CO_2) from 1 to 5 bar led to an improvement in methane rate production from 0.035 ± 0.014 mmol h^{-1} to 0.072 ± 0.019 mmol h^{-1}. Similar methane production rates were observed in reactors operated at the same H_2/CO_2 partial pressures, even when varying the total initial gas pressure. Hydrogen partial pressure was shown to determine the structure of bacterial communities and diversity decreased with increasing H_2/CO_2 partial pressure. No significant changes were observed for the archaeal communities.

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