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CH_4 PRODUCTION AT MODERATE H_2/CO_2 PRESSURES – INSIGHTS ON THE USE OF ANAEROBIC GRANULAR SLUDGE AS BIOCATALYST

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Introduction: The continuous increase in energy consumption and the intensive use of fossil fuels, lead to the emission of greenhouse gases (GHG) and, in particular, to an increase in the concentration of CO_2 in the atmosphere. In this context, the improvement in global awareness and the demand for sustainable technologies and products strongly contribute to laid plans to combat climate change.
CO_2-to-CH_4 conversion represents a cutting-edge solution for CO_2 capture and use, contributing to the reduction of GHG emission. Catalytic conversion of CO_2-to-CH_4 have been investigated, however, the high cost associated to the catalysts employed limits their use on a large scale. Biological CO_2 methanation can overcome the significant technical and economic challenges of catalytic CO_2 methanation. The biological production of CH_4 using CO_2-rich gases together with H_2 is a promising strategy for the production of bioproducts. Hydrogenotrophic methanogens have a crucial role on the direct conversion of CO_2+H_2 into CH_4, hence the importance to study the specific hydrogenotrophic methanogenic activity (SHMA).
Methodology: In this work, the effect of initial substrate (H_2/CO_2) pressure, from 100 to 500 kPa, on the SHMA, on CH_4 production rate and on developed microbial communities were evaluated. Two different pressurized bioreactors were studied using anaerobic granular sludge as the biocatalyst and H_2/CO_2 (80:20, v/v) as sole carbon and energy source. Gaseous compounds were analyzed by GC and archaeal diversity within granular sludge was monitored by 16S r-RNA based techniques.
Results: The results showed an increase in the SHMA as well as in the CH_4 production rate with the increase of the initial H_2/CO_2 pressure. This results are very interesting since no inhibitory effects were observed on the microbial activity, demonstrating the resistance of the anaerobic granular sludge. The Illumina results showed that *Methanosarcinales*, *Methanobacteriales* and *Methanomicrobiales* were the three orders that prevailed in the pressurized system, for all the pressures tested. However, hydrogenotrophic methanogens from *Methanobacterium* and *Methanospirillum* genera slightly increased their relative abundance, varying from 38% (100 kPa) to 41% (500 kPa) and from 8% (100 kPa) to 12% (500 kPa), respectively.
Conclusions: In conclusion, the archaeal community seems to be very stable when submitted to increasing H_2/CO_2 pressures, highlighting the potential of the anaerobic granular sludge as an efficient microbial platform for the production of added-value compounds from gaseous carbon waste streams.
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