Biomethanation of Syngas by Enriched Mixed Anaerobic Consortia in Trickle Bed Reactors

Two identical trickle-bed reactor setups were designed and operated under mesophilic conditions and atmospheric pressure, without pH control, for the biomethanation of syngas consisted of 45% H₂, 25% CO₂, 20% CO and 10% CH₄. The reactors were inoculated with mixed methanogenic microbial consortia formerly adapted to the gaseous mixture. During the start-up of the reactors acetic acid accumulation in the liquid broth resulted in a pH decrease to levels unfavorable for methanogenic activity. This was corrected by introducing a strong phosphate buffer in the medium (K₂HPO₄/KH₂PO₄ : 87 mM/13 mM). Channeling phenomena observed across the trickle bed were eliminated by setting a high liquid recirculation rate (1600 l/lbed/d). The reactors were operated for 294 days presenting minor deviations between them at the 24 extracted steady states and high cell retention even at a hydraulic retention time (HRT) of 3.7 days. At a gas residence time of 2.31 h and a HRT of 5.5 days the achieved CH₄ productivity was 2 mmol/lbed/h with 93% H₂ and 90% CO conversion efficiency and a 78% electron yield to CH₄. The conducted study verified that an enriched methanogenic microbial consortium can effectively convert syngas to CH₄ in a trickle bed reactor under appropriate operational conditions.

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