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Closed Nutrient Recycling via Microbial Catabolism in an Eco-Engineered Self Regenerating Mixed Anaerobic Microbiome for Hydrogenotrophic Methanogenesis

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A novel eco-engineered mixed anaerobic culture was successfully demonstrated for the first time to be capable of continuous regeneration in nutrient limiting conditions. Microbial catabolism has been found to support a closed system of nutrients able to enrich a culture of lithotrophic methanogens and provide microbial cell recycling. After enrichment, the hydrogenotrophic species was the dominating methanogens while a bacterial substratum was responsible for the redistribution of nutrients. q-PCR results indicated that 7% of the total population was responsible for the direct conversion of the gases. The efficiency of H_2/CO_2 conversion to CH_4 reached 100% at a gassing rate of above 60 v/v/d. The pH of the culture media was effectively sustained at optimal levels (pH 7-8) through a buffering system created by the dissolved CO_2. The novel approach can reduce the process nutrient/metal requirement and enhance the environmental and financial performance of hydrogenotrophic methanogenesis for renewable energy storage.

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