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Hydrogen mediated biogas upgrading in a two-stage mesophilic reactor

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In this study, biogas upgrading was tested in an innovative two-stage mesophilic reactor, where the CO_2 in the biogas was coupled with external H_2 and converted into CH_4 by hydrogenotrophic methanogenesis. The first stage was responsible for the most of the biogas produced, while in the second one, where the H_2 was injected, the CO_2 was converted to CH_4 (Fig 1). Prior to the H_2 addition, the biogas was composed by 70% CH_4 and 30% CO_2 . On the contrary, upon H_2 addition, the CO_2 content decreased to 9% upgrading the biogas to 89% CH_4 (Fig 2). Archaeal population increased to approximately the half of the total community. The increase of hydrogenotrophic methanogens, with *Methanoculleus* as dominant genus, and syntrophic bacteria and the decrease of acetoclastic methanogens and fermentative bacteria assert the selective pressure of the H_2 toward the hydrogenotrophic pathway, enhancing the CO_2 consumption and thus the biogas upgrading. Moreover, in absence of acetoclastic methanogenesis, acetate was likely degraded via syntrophic acetate oxidation with hydrogenotrophic methanogens, by bacterial groups such as *Thermoanaerobacteraceae* (1).



Fig 1: Two-stage reactor configuration.

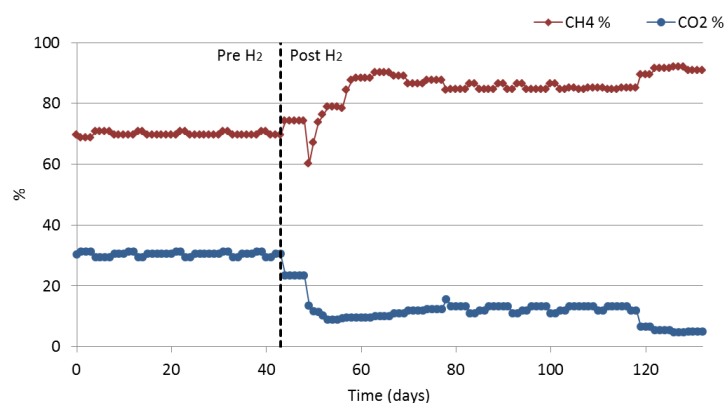


Fig 2: Biogas composition prior and after the H_2 addition.

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