Biogas Reforming for Bio-Chemicals Production in Italy

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Biogas is a mixture of methane, CO_2 and other gaseous components that derive from the anaerobic digestion of biomass. Around 2000, biogas plants for electricity and energy production are now operating in Italy, due to national incentives from 2008, which have now expired. In literature, two alternative routes seem most promising: fully upgrading biogas to biomethane and substituting natural gas in chemicals production by steam reforming (an endothermic catalytic process which produces CO, CO_2 and H_2). The difference lies in the CO_2 upgrading step; a purity of 98% is required for biomethane, while syngas involves the presence of carbon dioxide. The author's research focuses on biogas's role in decarbonising the Italian industrial sector, considering it a valuable source in reforming syngas technology. In literature, Bozzano et al. (2017) introduced the great potential of biogas for methanol production, Dietrich et al. (2020) investigated its application to hydrocarbons by Fischer-Tropsch, while, more recently, Kumar and Kumar (2024) reviewed the use for bio-hydrogen. The authors investigated biomethane and bio-syngas production for Italian plant sizing, focusing on optimal CO_2 removal configuration and economic feasibility. Further on, the authors had access to experimental data of a biogas reforming reactor for a small industrial scale (20 NM^3/h of biogas as nominal regime) on Italian ground. The data was collected and properly manipulated to remove outliers and close the mass balance to reach a feasible steady state data set. A model for the biogas steam reforming catalytic tube was then validated against experimental data, showing compatibility of the application with a syngas with a stoichiometric ratio between 1.2 and 2.0 (Figure 1). Current developments focus on the dynamic modelling of the unit for optimal control routines and operation on larger scales.

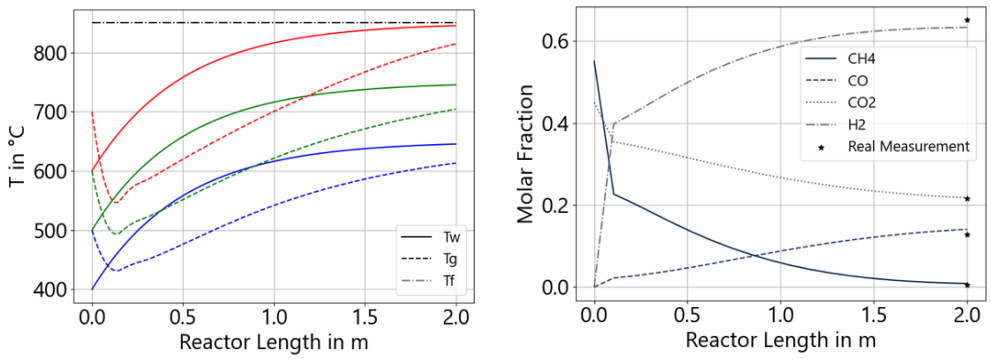

Figure 1 - Biogas reforming catalytic tube model results against experimental data.

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